SCIENTIFIC AMERICAN SUPPLEMENT. No 1351

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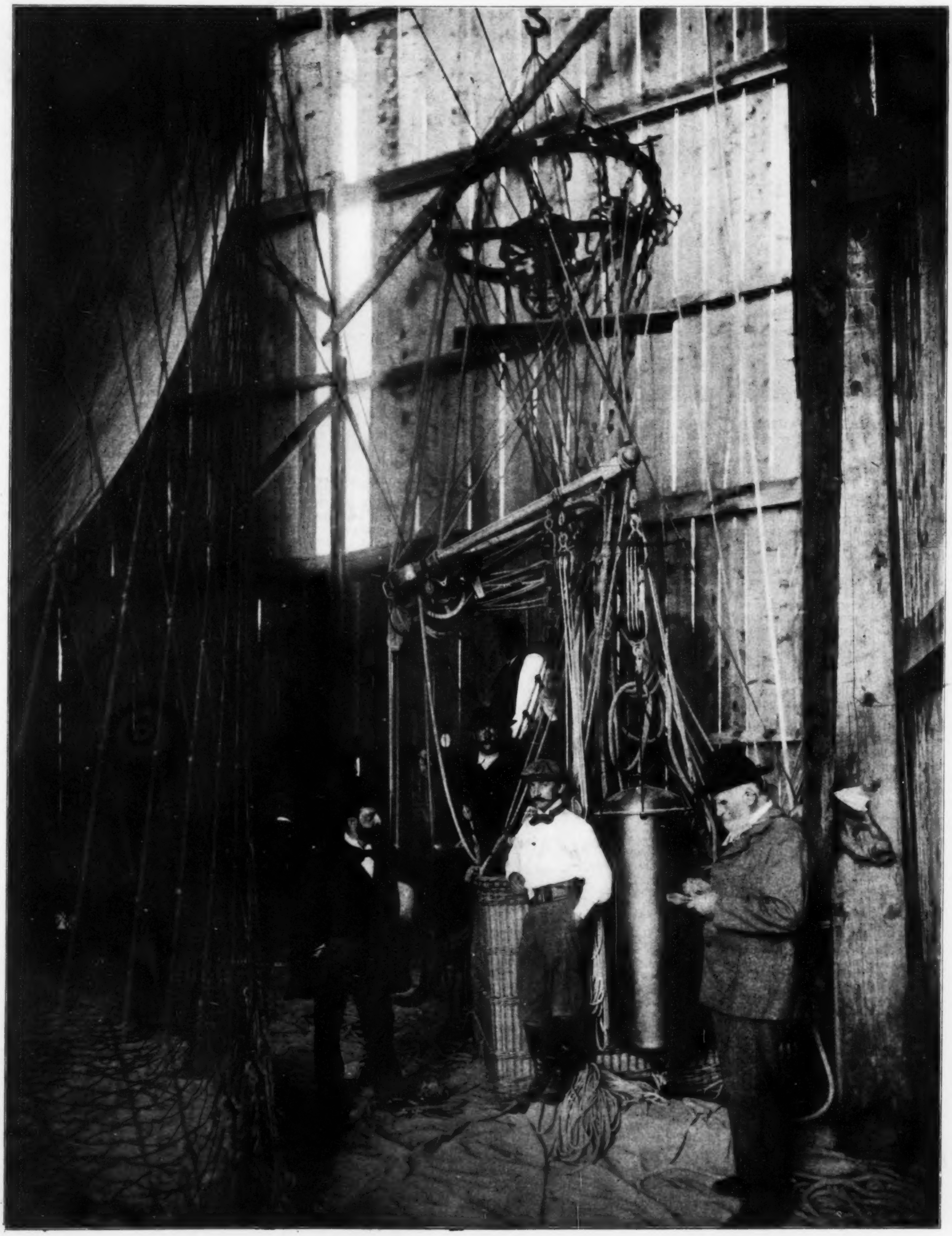
Scientific American, established 1845.
Scientific American Supplement. Vol. LII. No. 1351.

NEW YORK, NOVEMBER 23, 1901.

Scientific American Supplement. $5 a year.
Scientific American and Supplement. $7 a year.



M. H. Hervé. Count de la Vaulx. Count Castillon de Saint-Victor.

THE MEDITERRANEAN TRIP OF COUNT DE LA VAULX—INTERIOR OF THE BALLOON HOUSE, SHOWING THE TACKLE FOR MANEUVERING THE BALLOON.

COUNT DE LA VAULX BALLOON "MEDITERRANÉEN."

By Our Paris Correspondent.

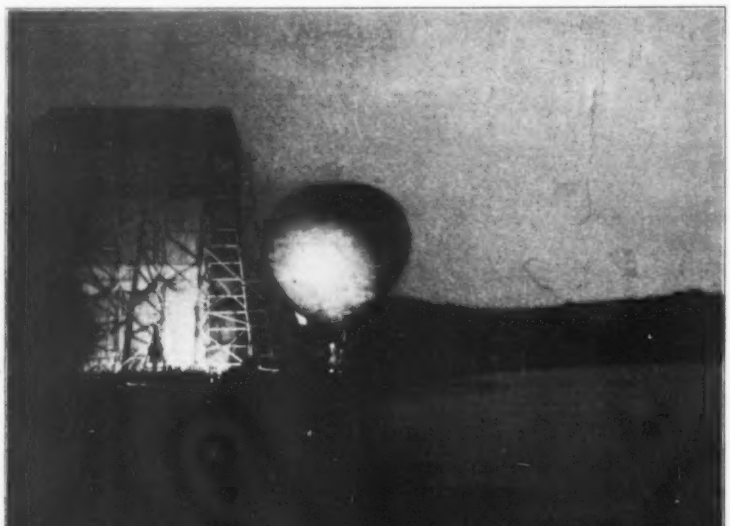
The Count de la Vaulx, speaking of his recent attempt to cross the Mediterranean in a balloon, says that he has been hindered by a great many unfavorable circumstances, which rendered it extremely difficult to carry out his project. Naturally, it was intended to make the start during the summer, but the balloon and the different apparatus could not be finished before the first of October. Again, while the balloon was being filled with hydrogen, he received word that the Minister of the Marine had decided to withdraw his support as well as the personnel which aided in the operations. The aeronauts, however, decided to continue and to make the start in any case. But as the hydrogen was generated under unfavorable conditions, it was not pure, and besides a considerable amount of air must have been admitted into the balloon, owing to a lack of competent attendance. When the time came for the start it was found that the balloon's lifting capacity was greatly diminished for the above reasons, and thus it became necessary to leave behind all the apparatus that was not absolutely necessary, such as the largest deviator, the two serpent-floats, the cylinders for taking water-ballast, the acetylene buoys, and various accessories. The engraving shows a view of the balloon taken by flashlight just before starting, on Saturday evening, October 12, at 11 o'clock. After launching, it made rapidly away from the coast, attached by its rope to the floater which kept the car a few feet above the sea, and drawing behind it the deviator, submerged below the surface. At the last moment, seeing that the aeronauts were determined to continue, the Minister of the Marine consented to have the balloon followed by the battleship "Du Chayla," in charge of Commandant Serpette.

"Shortly after our departure," says the Count, "we were located by the 'Du Chayla,' which kept its projectors turned upon the balloon and did not lose it from view. The first night passed very well, but unfortunately with a contrary wind, which took us continually along the coast. The whole day of Sunday we passed in the Gulf of Lyons. We encountered vessels with which we exchanged signals, and let loose our carrier-pigeons. In the night the balloon came to the south of Marseilles, and here the 'Du Chayla' approached us. We asked that the projectors be turned, not upon the balloon, but upon the apparatus in the sea, so that the maneuvers could be well carried out, and we announced our intention of remaining all night at six feet above the water. In fact, during the whole of the second night we kept at this short distance above the sea, moving along like the most stable ship, thus proving conclusively the good working of M. Hervé's apparatus. On the following morning (Monday) we found ourselves 30 miles to the northwest of Cape Creux. At daybreak the 'Du Chayla' again approached us and we told the Commandant that we counted upon remaining two or three days longer in the balloon, if the wind would only send us to the south, out of the Gulf of Lyons. Toward 2 P. M. the wind continued to push us to the northwest, and all that we could do with our smaller deviator was to steer toward the west. Soon we came in sight of the coast and the Pyrenees. It was now certain that we would soon have to land, much to our dissatisfaction, as the balloon was still good for 48 hours at least. Here Commandant Serpette set out toward us in the ship's boat, rowed by ten sailors, and the boat came just below the car. After conversing in this unique fashion with the Commandant, we found out that we were 29 miles from Perpignan, near the Spanish frontier, with a wind of two knots per hour. It was agreed that we should slow up speed as much as possible, so as not to arrive at the coast till the next morning. The 'Du Chayla' was to be ready to take us on board if we were obliged to land in the night.

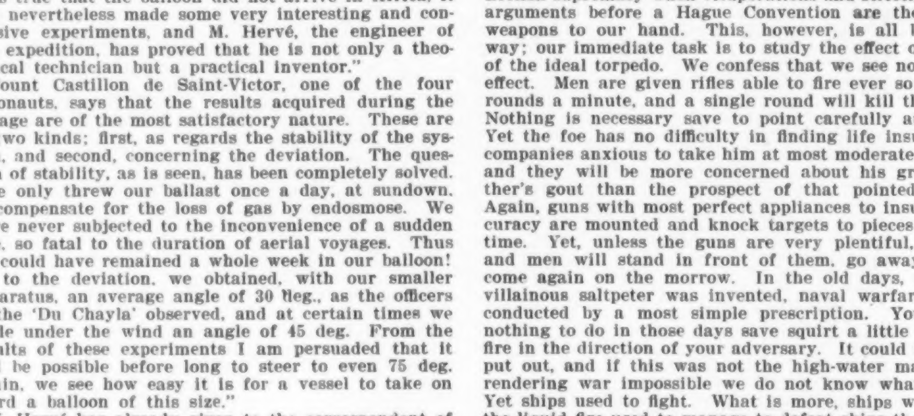
"Shortly afterward the breeze, which had been feeble up to this point, became much stronger, and we found that we would be obliged to land the same night upon an unknown coast, full of swamps, and perhaps during a storm, as the wind now became more violent. After consulting, we decided to make a landing upon the 'Du Chayla,' and accordingly, at 4 o'clock in the evening, we signaled the vessel, which approached and made ready for the landing. The forward deck was cleared, leaving a large space free. During this time the balloon slowed up speed by means of its cone-anchors, and the car was mounted a short distance above the level of the deck. The balloon now moved along with the wind and the ship followed directly behind it. The cruiser soon gained upon us and we were then just forward of the deck. Our ropes were caught by the vessel and the car was drawn down upon the deck and caught by two grappling-hooks. Thus we made the landing at 5 o'clock in the evening (Tuesday). The sailors held down the car and we descended on board. I then opened the side of the balloon by means of its tearing-rope, and it sank upon the water, whence it was taken up by the sailors, also the floating apparatus, and in two hours' time everything was arranged on board. Thus during 41 hours the 'Méditerranéen,' fixed to the surface of the sea, made its voyage like a simple ship, reversing the theories emitted up to the present as to the dangers of the sea for aerostats and showing that a well-equipped balloon cannot find a better field of action than the open sea. We remained in general at a height of 6 to 20 feet above the surface, but could have mounted as high as 300 feet. While it is true that the balloon did not arrive in Africa, it has nevertheless made some very interesting and conclusive experiments, and M. Hervé, the engineer of the expedition, has proved that he is not only a theoretical technician but a practical inventor."

Count Castillon de Saint-Victor, one of the four aeronauts, says that the results acquired during the voyage are of the most satisfactory nature. These are of two kinds; first, as regards the stability of the system, and second, concerning the deviation. The question of stability, as is seen, has been completely solved. "We only threw our ballast once a day, at sundown, to compensate for the loss of gas by endosmose. We were never subjected to the inconvenience of a sudden rise, so fatal to the duration of aerial voyages. Thus we could have remained a whole week in our balloon! As to the deviation, we obtained, with our smaller apparatus, an average angle of 30 deg., as the officers of the 'Du Chayla' observed, and at certain times we made under the wind an angle of 45 deg. From the results of these experiments I am persuaded that it will be possible before long to steer to even 75 deg. Again, we see how easy it is for a vessel to take on board a balloon of this size."

M. Hervé has already given to the correspondent of the Scientific American a complete description of his floating and steering apparatus, and the present experiment shows how well he has been able to carry out his theories as to the steering of balloons upon the sea. Naturally this steering has its limiting angle, and if the aeronauts had not encountered a quite unfavorable wind they would have undoubtedly been able to carry out their project and land on the coast of Africa. Better trials are to be made next spring when the weather is favorable.



THE DE LA VAULX BALLOON READY FOR THE START, 11 P. M.
PHOTOGRAPH TAKEN BY FLASH LIGHT.



MAKING READY THE CARRIER PIGEONS FURNISHED BY THE ARMÉE ET MARINE, PARIS

THE ORLING TORPEDO.

Naval warfare has been "revolutionized" again, and this time not by a submarine boat, says The Engineer. The Orling torpedo has been tried and succeeded. It was tried and succeeded before the King, in Sweden, a couple of years or more ago, but the matter made little noise at the time. Now the daily Press has got hold of it, and drawn some harrowing pictures of the future of naval warfare in consequence. There is, we believe, more than one torpedo in the field worked or to be worked with wireless telegraphy, X-rays, or some similar force as the steering agency. Some of them, perhaps, have been born in the newspaper offices; but the Orling is undoubtedly a *fait accompli* so far as experimental trials will take it; it is at least as much an actuality as the submarine, and neither milk nor special chemical tabloids are needed to keep the operator in existence. Something of the same kind is supposed to exist in the torpedo schoolship "Vernon." From Italy similar stories have come. All told, this type of weapon exists to-day in a more or less perfected form.

With the construction or the details of working we do not here propose to deal, our purpose being to discuss the effect of such a weapon on naval warfare. We will assume, therefore, that the weapon exists in a perfected state, ready for any Power that wishes to make use of it. The operator sits in a hidden shelter, his torpedo in the water below him. On the horizon is the enemy. He switches on the invisible motive power, the torpedo goes out, and steered by an unfaltering hand, finally strikes the enemy, and blows a million pounds worth of battleship to perdition. This is the picture in last week's newspapers, and there is no particular fairy tale about it. Archimedes' burning glasses which frizzled up the warships are nothing to it. Yet granted that all this can be done, we are by no means certain of its ability to revolutionize naval warfare, while we are absolutely sure that neither it nor any extended application of it is going to render war impossible. Which, we hasten to add, we do not much regret. The world has not yet reached a stage when such a consummation would be really desirable, however beautiful theoretically may be the picture of lions like the Kaiser lying down beside lambs like M. de Bloch or Mr. Stead, who have long ago demonstrated by sheer mathematics that war is impossible. Since men are not yet absolved from the law of nature that compels all progress to be by warfare, it is better for all concerned that that warfare shall now and again be conducted with guns, torpedoes, and rifles, than with tongue and pen alone. A study of the continental Press fills us with dim forebodings as to what will happen to British supremacy when vituperations and strictly legal arguments before a Hague Convention are the only weapons to our hand. This, however, is all by the way; our immediate task is to study the effect on war of the ideal torpedo. We confess that we see no great effect. Men are given rifles able to fire ever so many rounds a minute, and a single round will kill the foe. Nothing is necessary save to point carefully at him. Yet the foe has no difficulty in finding life insurance companies anxious to take him at most moderate rates, and they will be more concerned about his grandfather's gout than the prospect of that pointed rifle. Again, guns with most perfect appliances to insure accuracy are mounted and knock targets to pieces every time. Yet, unless the guns are very plentiful, ships and men will stand in front of them, go away, and come again on the morrow. In the old days, before villainous saltpeter was invented, naval warfare was conducted by a most simple prescription. You had nothing to do in those days save squirt a little Greek fire in the direction of your adversary. It could not be put out, and if this was not the high-water mark of rendering war impossible we do not know what was. Yet ships used to fight. What is more, ships without the liquid fire used to manage to defeat ships that had it. How? Well, the old chronicles tell us that on one

particular occasion Richard Cœur-de-Lion captured a Turkish battleship so armed, simply by verbal encouragement. "Then," says the historian, "did the king exhort his men, saying: 'Know well, that if this enemy be not taken, ye shall all be put to death with fearful tortures.'" This is rather more "exhortation" than could be gone in for nowadays, but modern equivalents are to be found if necessary. With the picture before us of Boers sitting down smoking under a hail of lyddite, we are, however, disposed to question whether any modern agent of destruction can possibly approach that liquid fire with which in past ages men cheerfully fought each other, and so to doubt whether much "exhortation" is likely to be required.

Certainly, no form of torpedo can outdo the fire. The torpedo is an eminently humane weapon, the odds being that a big ship thus struck will not sink, but be merely *hors de combat*. But as to being *hors de combat* by the X-ray torpedo directed from the shore—well, the prosaic naval captain is more likely to "out torpedo nets," and trouble no more. The human race that managed to evolve antidotes to a thing like Greek fire is not going to be at a loss to find antidotes to anything less at this stage of the world's history. And so, instead of the sinking battleship, we see, rather, torpedo nets, and steam pinnaces phlegmatically going between the operator and his Hertz ray torpedo, with a screen that will nullify his efforts.

So much for the new weapon as concerns shore defense. Attempts will certainly be made to apply it for sea warfare also. We are not going to waste space with dreams of rival currents and the like, reducing operations to a species of "puff billiards." Ample contrary forces exist with things as they are. The torpedo has to be directed. Who is going to do it, and whence? Submerged tubes are, in evolutions, directed from the conning tower, and their range in these days of gyroscopes is a mile. But what of the battle, when high-explosive shells are bursting, filling the ship and all around her with dense and suffocating smoke? Even if the conning tower survives, he will be a lucky man who gets even the momentary clear glimpse necessary to discharge a torpedo from a submerged tube. How by any possible chance is he to divert over a long space of time a torpedo that he has to steer? At moderate ranges he will have no vision of the enemy enough to admit of a fair trial of his weapon; at longer ranges, how is he going to follow his torpedo through intervening waves, against a speck hardly visible, and in face of vibrations that render a far less complex instrument, such as a range finder, very difficult to use? To have any chance whatever, the operator will have to be installed high upon a mast, and once he becomes a war factor, the prosaic enemy will dose him there with shrapnel.

We express no opinion on the merits or demerits of the invention as an invention *pur et simple*, we merely point out that a rather large gap usually exists between the real and the ideal.

GOLD PAINT.

By W. A. DAWSON.

THE formulæ of the various gold paints on the market are carefully guarded trade secrets. Essentially they consist of a bronze powder mixed with a varnish. The best bronze powder for the purpose is what is known in the trade as "French flake," a deep gold bronze. This bronze, as seen under the microscope, consists of tiny flakes or spangles of the bronze metal. As each minute flake forms a facet for the reflection of color, the paint made with it is much more brilliant than that prepared from finely powdered bronze.

For making gold paint like the so-called "washable gold enamel" that is sold by the manufacturers at the present time, it is necessary to mix a celluloid varnish with the French flake bronze powder. This varnish is made by dissolving transparent celluloid in amyl acetate in the proportion of about five per cent of celluloid.

Transparent celluloid, finely shredded. 1 ounce.
Acetone, sufficient quantity.
Amyl acetate.................to make 20 ounces.

Digest the celluloid in the acetone until dissolved and add the amyl acetate. From one to four ounces of flake bronze is to be mixed with this quantity of varnish. For silver paint or "aluminium enamel," flake aluminium bronze powder should be used in place of the gold. The celluloid varnish incloses the bronze particles in an impervious coating, air-tight and watertight. As it contains nothing that will act upon the bronze, the latter retains its luster for a long period, until the varnished surface becomes worn or abraded and the bronze thus exposed to atmospheric action.

All of the "gold" or, more properly, gilt furniture that is sold so cheaply by the furniture and department stores is gilded with a paint of this kind, and for that reason such furniture can be offered at a moderate price. The finish is surprisingly durable, and in color and luster is a very close imitation of real gold leaf work. This paint is also used on picture frames of cheap and medium grades, taking the place of gold leaf or the lacquered silver leaf formerly used on articles of the better grades; it is also substituted for "Dutch metal," or imitation gold leaf, on the cheapest class of work.

A cheaper gold paint is made by using an inexpensive varnish composed of gutta-percha, gum dammar, or some other varnish gum, dissolved in benzole, or in a mixture of benzole and benzine. The paints made with a celluloid-amyl-acetate varnish give off a strong banana-like odor when applied, and may be readily recognized by this characteristic.

The impalpably powdered bronzes are called "lining" bronzes. They are chiefly used for striping or lining by carriage painters; in bronzing gas fixtures and metal work; in fresco and other interior decoration, and in printing; the use of a very fine powder in inks or paints admits of the drawing or printing of very delicate lines.

Lining bronze is also used on picture frames or other plastic ornamental work. Mixed with a thin weak glue sizing it is applied over "burnishing clay," and when dry is polished with agate burnishers. The object thus treated, after receiving a finishing coat of a thin transparent varnish, imitates very closely in appearance a piece of finely cast antique bronze. To add still more to this effect the burnishing clay is colored the green-black that is seen in the deep parts of real antique bronzes, and the bronze powder, mixed with size, is applied only to the most prominent parts or "high lights" of the ornament.

Since the discovery of the celluloid-amyl-acetate varnish, or bronze liquid, and its preservative properties on bronze powders, manufacturers have discontinued the use of liquids containing oils, turpentine, or gums, since their constituents corrode the bronze metal, causing the paint to finally turn black.—Bulletin of Pharmacy.

ENAMELING.—III.

FROM THE SHEET TO THE SIGN TABLET.

THE simplest method of imparting a practical and concise description of the enameling process is by following the various operations through each successive stage from the time the metal is received until it is turned out as a salable enameled article. The plates are generally in lengths of 6 feet by 2 feet, 6 feet by 3 feet, etc., the gage generally being from 14 to 22, according to the size and class of plates to be enameled. These require to be cut, but some enamelers prefer to order their plates in specified sizes, which does away with the necessity of cutting at the enameling factory. In order, however, to make this article complete, we shall assume that a stock of large plates is kept in hand, the sizes being 6 feet by 3 feet and 6 feet by 2 feet. An order for sign tablets is given; particulars, say as follows: Length, 2 feet by 12 inches; white letters on blue ground; lettering, The Engineer,

Fig. 1

Fig. 2

33 Norfolk Street; block letters, no border line, two holes. For ordinary purposes these particulars would be sufficient for the enameler.

Stage I.—Cutting the plate is the first operation. The plates 6 feet by 2 feet would first be cut down the center in a circular cutting machine, thus forming two strips 6 feet by 12 inches. Each strip would then be cut into three lengths of 2 feet each. If a guillotine had to be used instead of a circular cutter, the plate would be first cut transversely at distances of 2 feet, thus forming three square pieces of 2 feet by 2 feet. These would then be subdivided longitudinally into two lengths each, the pieces being then 2 feet by 12 inches. Each sheet would thus be cut into six plates.

Stage II.—The cut plates should next have any roughness removed from the edges, then punched with two holes—one at each end, followed by leveling or setting. This is done by hammering carefully on a true flat surface.

Stage III.—The plates should then be taken and dipped into a hydrochloric acid bath made up of equal quantities of the acid and water. The plates are then raised to a red heat in the stoves, and on removal it will be found that the scale—iron oxide—has become loosened, and will readily fall off, leaving a clean metallic surface. A second course of cleaning then follows in diluted sulphuric acid—1 part acid to 20 parts water. In this bath the iron may be kept for about twelve hours. In some cases a much stronger bath is used, and the plates are left in only a very short time. The bath is constructed of hard wood coated inside with suitable varnish.

In mixing the sulphuric acid bath it must be remembered that the acid should be slowly poured into the water under continuous stirring. Following the bath, the metal is rinsed in water, after which it is thoroughly scoured with fine flinty sand. Rinsing again follows, but in boiling water, and then the metal is allowed to dry. The enameling process should immediately follow the drying, for if kept for any length of time the surface of the metal again becomes oxidized. In hollow-ware enameling the hydrochloric acid bath may be omitted.

Stage IV.—The plates are now ready for the reception of the foundation or gray coating. If powder is used the plate is wiped over with a gum solution, and then the powder is carefully and uniformly dusted through a fine sieve over the surface. The plate is then reversed, and the operation repeated on the other side. If a liquid "gray" is to be used it should have a consistency of cream, and be poured or brushed with equal care over the two surfaces in succession, after the plate has been heated to be only just bearable to the touch. The plates are then put on rests, or petits, in a drying stove heated to about 160 deg., and when thoroughly dry they are ready for the fusing operation. The petits, with the plates, are placed on a long fork fixed on a wagon, which can be moved backward and forward on rails; the door of the fusing oven is then raised and the wagon moved forward. The fork enters the oven just above fireclay brick supports arranged to receive the petits. The fork is then withdrawn and the door closed. The stove has a cherry-red, almost white heat, and in a few minutes the enamel coating has been uniformly melted, and the plates are ready to be removed on the petits and fork in the same manner as they were inserted. Rapid cooling must now be carefully avoided, otherwise the enamel and the iron will be liable to separate, and chipping will result. The temperature of fusion should be about 1,200 deg. C.* When all the plates have been thus prepared they are carefully examined and defective ones laid aside, the others being now ready for the next operation.

Stage V.—The coating of the plate with white is the next stage. The temperature of fusion of the white glaze is lower than that of the gray, so that the plate will remain a shorter time in the stove, or be submitted to a somewhat lower temperature. The latter system is to be strongly recommended in order to prevent any possibility of fusion of the ground mass. The white should be made as liquid as possible consistent with good results. The advantages of thin coatings have already been explained, but if the mixing is too thin the ground coating will not only be irregularly covered, but, in fusion, bubbles will be produced, owing to the steam escaping, and these are fatal to the sale of any kind of enameled ware. When the plate has been thoroughly dried and fusion has taken place, slow and steady cooling is absolutely essential. Special muffles are frequently built for this purpose, and their use is the means of preventing a large number of wasters. Before putting on the glaze, care must be taken to remove the gray from any part which is not to be coated. The temperature of fusion should be about 1,050 deg. C.,* and the time taken is about five minutes.

Stage VI.—The stencil requires to be cut with perfect exactitude. The letters should be as clear as possible, proportioned and spaced to obtain the best effects as regards boldness and appearance. Stencils can be cut either from paper, or from specially prepared soft metal, called stencil metal. The former are satisfactory enough when only a few plates are required from one stencil, but when large quantities are required, say, sixty upward, metal stencils should be used. The paper should be thick, tough, and strong, and is prepared in the following manner: Shellac is dissolved in methylated spirits to the ordinary liquid gum form, and this is spread over both sides of the paper with a brush. When thoroughly dry a second protective coating is added, and the paper is then ready for stencil work. The stencil cutter's outfit consists of suitable knives, steel rule, scales of various fractions to an inch, a large sheet of glass on which the cutting is done, and alphabets and numerals of various characters and types. For ordinary lettering one stencil is enough, but for more intricate designs two, three, and even four stencils may be required. In the preparation of the plates referred to in the paragraph preceding Stage I. only one stencil would be necessary. The paper before preparation would be measured out to the exact size of the plate, and the letters would be drawn in. The cutting would then be done, and the result shown at Fig. 1 would be obtained, the black parts being cut out. The lines and corners of each letter or figure should be perfectly clear and clean, for any flaw in the stencil will be reproduced on the plate.

Stage VII.—The next stage is the application of the blue enamel. The operation is almost identical with that of the white, but when the coating has been applied and dried, the lettering must be brushed out before it is fused. The coating is generally applied by a badger brush after a little gum water has been added; the effect of this is to make the blue more compact.

Stage VIII.—The next operation is brushing; the stencil is carefully placed over the plate, and held in position, and with a small hand brush with hard bristles the stencil is brushed over. This brushing removes all the blue coating, which shows the lettering and leaves the rest of the white intact. When this has been done, the stencil is removed and the connecting ribs of the lettering—some of which are marked X in Fig. 2—are then removed by hand, the instrument generally being a pointed stick of box or corner wood.

Stage IX.—Fusing follows as in the case of the white glaze, and the plate is complete. One coat of blue should be sufficient, but if any defects are apparent a second layer is necessary.

The white and blue glazes are applied only on the front side of the plate, the back side being left coated with gray only.

FROM THE SHEET TO THE HOLLOW-WARE.

In hollow-ware enameling the iron is received in squares, circles or oblongs, of the size required for the ware to be turned out. It is soft and ductile, and by means of suitable punches and dies it is driven in a stamping press to the necessary shape. For shallow articles only one operation is necessary, but for deeper articles from two to six operations may be required, annealing in a specially constructed furnace taking place between each. Following the "drawing" operations comes that of trimming; this may be done in a press or spinning lathe, the object being to trim the edges and remove all roughness. The articles are now ready for enameling. For explanation, let us suppose they are tumblers, to be white inside, and blue outside, the gray is first laid on, then the white, and lastly the blue—that is, after the pickling and cleaning operations have been performed. The line of demarkation between the blue and white must be clear, otherwise the appearance of the article will not be satisfactory. The process of enameling is exactly the same as for sign-plate enameling, but more care must be exercised in order to arrive at a smoother surface. While the liquid enamels are being applied, circular articles should be steadily rotated in order to let the coating flow uniformly and prevent thick and thin places. The enameling of "whole drawn" ironware presents no difficulty to the ordinary enameler, but with articles which are seamed or riveted, special care and experience is necessary.

Seamed or riveted parts are, of course, thicker than the ordinary plate, will expand and contract differently, will take longer to heat and longer to cool, and the conclusion, therefore, that must be arrived at is that the thickness should be reduced as much as possible, and the joints be made as smooth as possible. Unless special precautions are taken, cracks will be seen on articles of this kind running in straight lines from the rivets or seams. To avoid these, the enamel liquid must be reduced to the greatest stage of liquidity, the heat must be raised slowly, and in cooling the articles should pass through, say, two or three muffles, each one having a lower temperature than the preceding one. It is now generally conceded that the slower and more uniform the cooling process is the greater will be the durability of the enamel. Feldspar is an almost absolutely necessary addition to the gray

* Melting a piece of copper will approximately represent this temperature.

* Melting a piece of brass will represent this temperature.

in successful hollow-ware enameling, and the compositions of both gray and white should be such as to demand a high temperature for fusion. The utensils with the gray coating should first be raised to almost a red heat in a muffle, and then placed in a furnace raised to a white heat. The white should be treated similarly, and in this way the time taken for complete fusion at the last stage will be about four minutes.

The outside enamel on utensils is less viscous than the inside enamel, and should also be applied as thinly as possible.

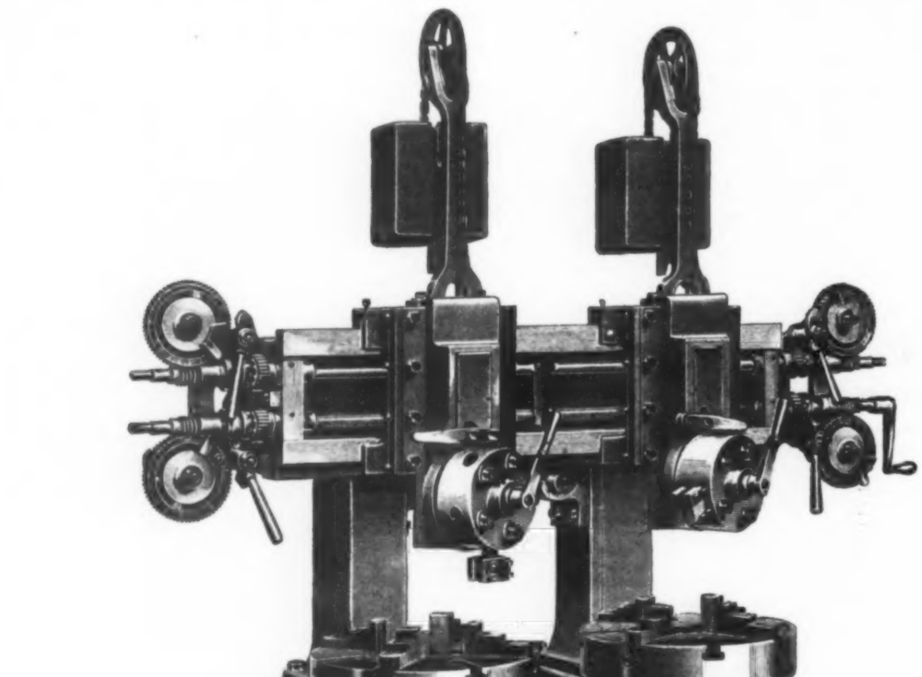
DOUBLE BORING AND TURNING MILL.

For certain classes of work the vertical lathe has many advantages over the ordinary lathe. This is not by any means the case only with heavy work. There are many lighter jobs which can be more conveniently machined in a vertical mill than a lathe, and the saving of space when only short work is to be done is considerable. An example of the type of machine suitable for such work is illustrated herewith. This vertical lathe has been recently completed by Webster Bennett, of Coventry, for James Simpson & Company, of Pimlico. The general characteristics are shown very clearly in the engraving. The combination of two machines in one is an excellent point. It is quite possible for one operator to look after at least two pieces of work, and labor susceptibilities do not appear to be offended if both pieces of work are on one bed-plate. The boring mill lends itself admirably to this duplex treatment, because both pieces are easily arranged to be in full view of the operator.

To facilitate the use by one man, the feeds, vertical and horizontal, are automatic, and have indicated trip motions, which are extremely useful in preventing overrunning. Where possible it is found most advantageous to bore on one table and turn on the other, thus keeping up a regular succession of finished pieces from the machine. The turrets are bored to receive five tools, of which a sample one is shown in the engraving.

They are inclined to allow of their working closer to each other than would be otherwise possible, and they are balanced for ease in manipulation, and have a quick return and advance by hand. The two machines are quite independent of each other in the matter of table speeds and feeds. The down feed is by worm wheel and rack. The rate of feed is altered by pressing or pulling a knob at either end of the cross slide; the set of three wheels has a sliding feather. The cones are large, and the countershafts have two speeds giving ten table speeds. The table bearings are large and adjustable; they are driven by independent cones and belts. A ring running in oil supports the table near its periphery, a feature which adds greatly to its stability.

The trip gear is very neat and simple, is in full view of the operator, and can be changed instantly while the machine is at work. There are four similar gears, one for vertical and cross travel for each head. This gear is shown in the engraving. It consists of a graduated worm wheel, to which a tappet can be clamped in any desired position. Any self-acting motion is put in by moving a corresponding lever which causes a clutch to engage; the tappet, as the worm wheel slowly revolves, ultimately hits a toe coupled to the clutch lever, and thus throws the clutch out.



DOUBLE BORING AND TURNING MILL.

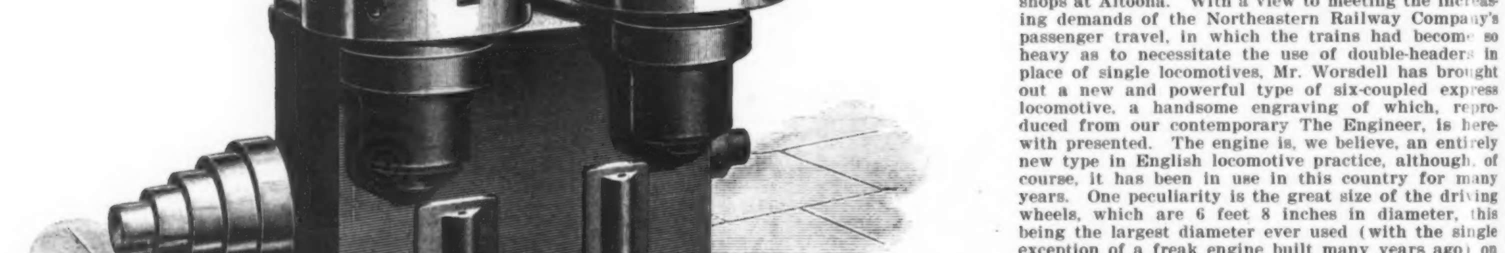
The machine illustrated is suitable for turning pieces up to 14 inches diameter by 7 inches high; larger sizes for 24-inch and 30-inch work are also made.—We are indebted to the London Engineer for the description and engraving.

ELEVATOR ACCIDENTS.

Few methods for the transportation of passengers have a higher percentage of safety than the modern passenger elevator. Within a short time, however, several accidents have occurred in Boston which are worthy of close investigation. In comment, the American Architect says: "In manufacturing buildings or warehouses, where elevators are used primarily for freight, and are employed for conveyance of persons only by the employés of the house and under explicit warnings about the risk, it is to be expected that accidents will occasionally occur; but a passenger elevator in one of the newest first-class office buildings on State Street is said to have fallen four times within about as many weeks; and, still more recently, an elevator in a new and fine apartment house in the suburbs fell through a distance of eight stories. Ten years ago, elevator accidents were not uncommon, both in apartment houses and office buildings; but, since that time, the construction of hoisting machines has been improved, and the system of insurance and inspection, now applied to nearly all passenger elevators, has provided against effects of wear and corrosion which, without such inspection, would pass unnoticed. That accidents should have begun again in a class of elevators which have for years been practically free from them is a matter of much significance, and it is to be hoped that the official inspectors of elevators, who now hold office in all our large cities, as well as the casualty insurance companies, which have a serious interest in efficient inspection, will be able to reassure the public, not only by an explanation of the mishaps which have already occurred, but by satisfactory assurances that similar accidents are not to be looked for elsewhere."

POWERFUL EXPRESS LOCOMOTIVE FOR THE NORTHEASTERN RAILWAY, ENGLAND.

Of late years the Northeastern Railway has been well in the lead among English railroads in appreciating the tendency of locomotive development and introducing the most advanced ideas. This is largely due to the initiative of Mr. Wilson Worsdell, chief mechanical engineer of the Northeastern Railway, who has been always rather closely in touch with American ideas, and whose predecessor in office spent a considerable period of time in the Pennsylvania Railway shops at Altoona. With a view to meeting the increasing demands of the Northeastern Railway Company's passenger travel, in which the trains had become so heavy as to necessitate the use of double-headers in place of single locomotives, Mr. Worsdell has brought out a new and powerful type of six-coupled express locomotive, a handsome engraving of which, reproduced from our contemporary The Engineer, is herewith presented. The engine is, we believe, an entirely new type in English locomotive practice, although, of course, it has been in use in this country for many years. One peculiarity is the great size of the driving wheels, which are 6 feet 8 inches in diameter, this being the largest diameter ever used (with the single exception of a freak engine built many years ago) on a locomotive of the six-coupled type. The cylinders, which are 20 inches in diameter by 26 inches stroke, are carried on the outside of the frames. The center of the boiler, which is of steel, is 8 feet 6 inches above the rails; the barrel is 15 feet 10½ inches in length by 4 feet 9 inches in diameter; the tube plate is of copper, and the outside shell of the fire-box is of steel. The inside of the fire-box, which is of copper, measures 7 feet 3½ inches in length by 3 feet 2½ inches in width. There are 193 2-inch tubes, with a heating surface of 1,639 square feet. Adding to this the fire-box heating surface, 130 square feet, we get a total heating surface of 1,769 square feet which, by the way, is less than half the heating surface of the new express engines of the Atlantic type on the New York Central & Hudson River Railroad. The fire-grate area is 23 square feet. The tender is of the standard English 6-wheeled, rigid-base type. It carries 4,729 gallons of water and 5 tons of coal. The boiler pressure is 200 pounds to the square inch. With a load of 400 American tons behind the tender, one of these engines has covered a distance of 57½ miles in 62 minutes; and on the same run a speed of 53 miles an hour was reached on a gradient of 1 in 200, while up a 5-mile grade of 1 in 96, the speed never fell below 28, and averaged 30 miles, an hour. These are excellent results, and there is little doubt that the six-coupled type will be adopted on other roads on which the train loads are beginning to exceed the hauling power of the engines.



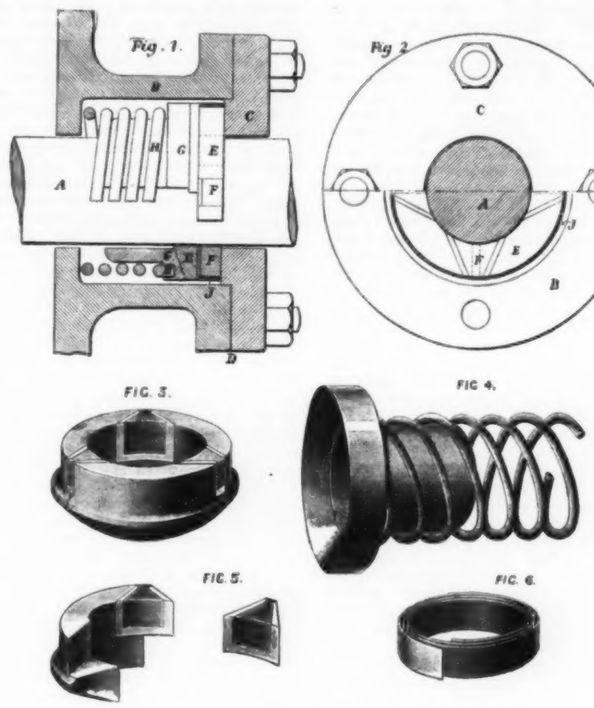
NEW SIX-COUPLED EXPRESS LOCOMOTIVE FOR THE NORTHEASTERN RAILWAY, ENGLAND.

THE LARGEST ENGLISH LOCOMOTIVE EVER BUILT.

WARD'S METALLIC GLAND PACKING.

WE illustrate, says The Engineer, a form of metallic packing now being made by Messrs. S. A. Ward & Co., of Broad-street Lane, Sheffield. The packing is shown complete in Figs. 1 and 2, while its constituents are separately illustrated in the remaining engravings. In Figs. 1 and 2 the piston-rod is denoted by *A* and the stuffing-box by *B*; *G* is a bush which is a loose fit on the rod, and which, being under the pressure of the spring, *H*, serves to keep the other constituents of the packing in place.

The remainder of the packing consists of six pieces, lettered respectively *E* and *F*. These are shown separately in Fig. 5, and in their proper position for fitting round the rod in Fig. 3. After being thus put together, the spring shown in Fig. 6 is slipped over the whole, and serves to keep them together. As indicated in Fig. 1, the pieces, *E*, rest on a beveled seat turned on the bush, *G* (Fig. 4.) The cover, *C*, which closes the stuffing-box after the packing is in place, is finished off true on its inner face, thus making a steam-tight joint with the opposing faces of the packing pieces, *E* and *F*. The packing can be used inside any ordinary stuffing-box without alteration, and, once in place, requires no readjustment. Renewals, when necessary, can be made in a few minutes, but in general the packing pieces are found to last for years.



WARD'S METALLIC GLAND PACKING.

A SMALL GASOLINE MOTOR.

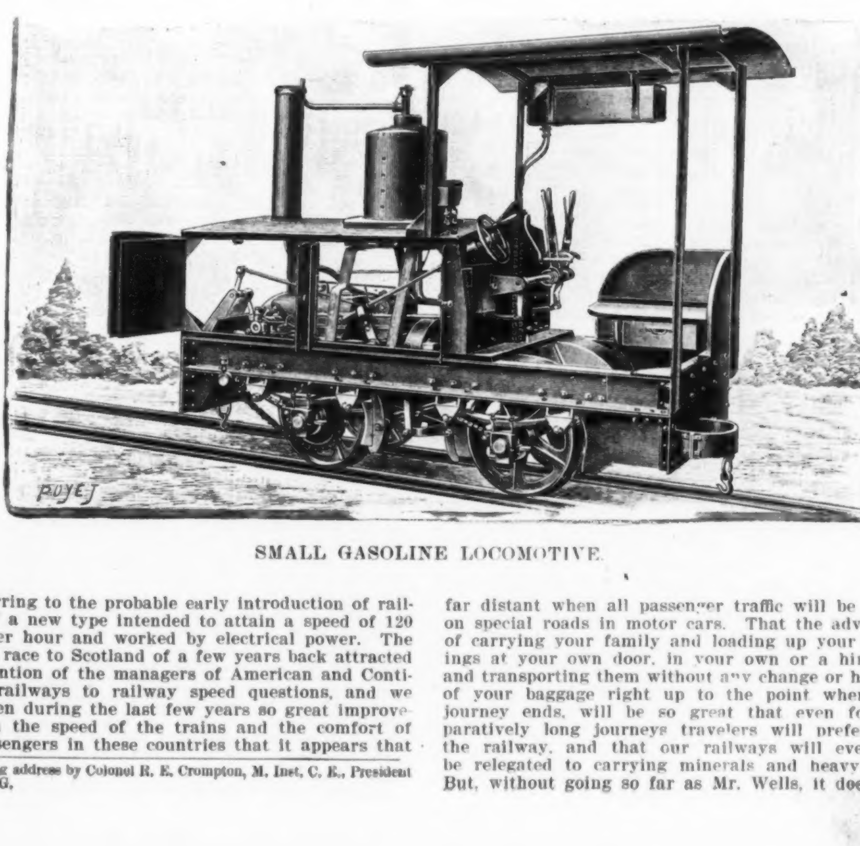
WHEN we think of the great advantages of gasoline motors, we may be astonished that they are not used to a greater extent upon railway and tramway lines where the traffic is not important enough to require the rational use of a steam locomotive. With its instantaneous starting and its small consumption of water, which might even become useless when the cooling was done by means of air, a gasoline locomotive would be indicated either for factories, where trains have to be run only at infrequent intervals, or for the active centers of public works, where the storage of water and fuel is very inconvenient. The "Anciens Etablissements Panhard et Levassor," a house well known for its automobiles, has just put to profit the experience that it has acquired in the construction of automobile motors for the manufacture of a small locomotive answering such requirements, and a photograph of which we reproduce herewith.

The motor is absolutely identical with that of the Panhard-Levassor carriages, and is supplied by gasoline of 700 deg. density vaporized in a constant level carbureter. The sparking is done by means of platinum tubes kept incandescent under pressure. The combustion chamber is constantly cooled externally through a circulation of water assured by a thermo-siphon. The regularity of the running is guaranteed by the use of an 88-pound flywheel, while a governor maintains the velocity of the motor at 750 revolutions, and prevents the lifting of the exhaust valves when such velocity begins to be exceeded.

The general form of this hauler recalls the characteristic aspect of a locomotive. It will be remarked, moreover, that all the housings of the mechanical parts may be opened through doors so as to give access to such parts and permit of their being inspected whenever it is necessary.

The motion of the motor is communicated to the front wheels through the intermedium of a train of gear wheels and change of speed analogous to that found in the Panhard-Levassor automobiles. The connection of the motor with such mechanism is effected through a friction clutch, in which leather rubs against iron. In order to prevent too rapid a motion, which is absolutely useless and even injurious in the service that has to be performed by a locomotive of this kind, a train of gear wheels is interposed between the change of speed and the shaft that carries the chain sprockets. There is no necessity of dwelling upon the arrangements, which may be understood from a simple inspection of the figure; but we may remark that, for the convenience of the engineman, the levers for starting, reversing, and changing the speed, as well as the brake levers, are all located upon the rear platform in front of his seat. A crank, with a pitch chain transmission, permits of giving the first impulsions to the motor, without its being necessary for the engineman to descend from the platform.

It is evident that when an electric current is dispesable, it is simpler to employ electric traction; but in other cases a small locomotive of this kind, capable of handling a weight of 3 tons burden, with the greatest facility, is destined to render genuine services.—For the above particulars and the engraving we are indebted to La Nature.



SMALL GASOLINE LOCOMOTIVE.

THE BRITISH ASSOCIATION AT GLASGOW.

MECHANICS.*

AT this the first meeting of the British Association of the new century I wish to lay before you some of the interesting problems presented by recent developments in means of locomotion on land which demand the best thoughts, not only of our engineers, but of everyone interested in the improvement in means of traveling and in the more rapid transit of goods.

During the seventy years which have passed since the introduction of railways in almost every country, passenger and goods traffic has developed itself to such an extent that almost everyone is interested in these questions; and of late years our attention has not been confined to railways only, but, owing to the invention of the cycle and motor-car, has also been directed to travel on our roadways, which during the first fifty years of the railway era has somewhat fallen into disuse. I am not able, being limited to the length of this address, to deal with many of the interesting questions affecting our long-distance railways other than by referring to the probable early introduction of railways of a new type intended to attain a speed of 120 miles per hour and worked by electrical power. The railway race to Scotland of a few years back attracted the attention of the managers of American and Continental railways to railway speed questions, and we have seen during the last few years so great improvement in the speed of the trains and the comfort of the passengers in these countries that it appears that England has already been beaten in the matter of extreme railway speed, although it is probable that our railways still provide a larger number of rapid trains than either the American, German, or French do. But whether it be in England or in the countries I have mentioned, it appears that after all the speed limit of railways of the present system of construction is reached at about sixty-five or seventy miles per hour. Higher speed on level runs has undoubtedly been recorded, but it is not probable that anything greatly in excess of seventy miles per hour will be reached until our railway managers initiate an entirely new system of construction. The high-speed service that is now in contemplation, not only in England, but in America and Germany, intends to attain speeds of more than one hundred miles per hour by providing electrical means of haulage sufficient to propel light trains consisting of one, or, at the most, a few cars; and in order to render this service successful to run these light trains at short intervals of time, so in effecting this high speed the railways will give a service which more nearly resembles the tramway service than our present system of heavy express trains at infrequent intervals. This high-speed service of light trains at frequent intervals is well suited to electrical haulage, as it works generating machinery situated at fixed points to the best advantage and enables the best return to be obtained from the necessarily heavy capital cost of copper in the conductors which transmit the energy along the length of the line, as it is evident that if the speed be sufficient to insure that each section of the line only carries one running train, the cost of the conductors will be in proportion to the weight of that train.

Great advantages have already been made in adapting electrical traction to long lengths of railways. The work already done by Brown Boveri, of Baden, in Switzerland, at first on the mountain railways and afterward on the Burghdorf-Thun full-gage line, the experimental work of Ganz & Company, of Buda-Pesth, and of Siemens & Halske at Charlottenburg, have already shown that the power problems are nearly all of them solved, so that we may feel confident that electrical engineers will very shortly surmount any power difficulties that still remain. But this high-speed railways problem at present presents certain unknown factors which can only be satisfactorily determined by the actual testing and working the lines when carrying passengers. I refer to those which deal with the increased oscillation, vibration, and noise to be expected from the extreme speeds. These matters must be met so as to give sufficient comfort and protection to the passengers, for if passengers are rendered uncomfortable by the extreme speed the service can never become popular, and on this last question depends the most important question of all, viz., the extent to which the traveling public are likely to make use of a high-speed railway service. In attempting to forecast this matter, although we meet many business men who think it would be an undoubted advantage if the journeys between important business centers occupied half the time they do at present, in the United Kingdom there are only a few journeys of sufficient length to make saving of time of great importance; but the case is far different in America and on the Continent, where the business centers are much further apart than they are here. I, as an English engineer, foresee that this topographical question will cause our English engineers to be at a disadvantage as compared with American and Continental ones, for it appears likely that the number and mileage of high-speed railways is likely to be far greater in America and on the Continent than in the United Kingdom. Before I entirely leave the subject of very high-speed railways, a rather curious speculation presents itself to us; this is whether the need for rapid communication between town and town may not eventually be supplied by high-speed motor-cars on roads specially prepared for them. Mr. Wells in his interesting forecast in The Fortnightly Review seems to think that the time is not far distant when all passenger traffic will be carried on special roads in motor cars. That the advantages of carrying your family and loading up your belongings at your own door, in your own or a hired car, and transporting them without any change or handling of your baggage right up to the point where your journey ends, will be so great that even for comparatively long journeys travelers will prefer it to the railway, and that our railways will eventually be relegated to carrying minerals and heavy goods. But, without going so far as Mr. Wells, it does seem

* Opening address by Colonel R. E. Crompton, M. Inst. C. E., President of Section G.

probable that if only a few passengers require to travel between two business centers such as Manchester and Liverpool, and to occupy only half the time from door to door at present taken by the railway and the two terminal cab rides, it might be better to provide one of Mr. Wells' improved roads on which private owners could run their own cars, paying toll for the road, and on which a public service of cars would provide for those who did not own cars themselves.

I now propose to deal at somewhat greater length with what I think is a most important problem in locomotion, viz., that caused by the congestion of street traffic in our towns and by the undoubted difficulties which exist in carrying our workers to and from their homes in the country to their places of employment in our towns. A large proportion of the workers who during the latter half of the last century lived and worked in the country are now working in towns, although some of them still live outside in order to obtain the advantages of lower rents and of a healthier life for their families, and this last class is likely to increase largely. Those who have been responsible for the enlarging and improvements of our towns have done so much to make town life preferable to country life that the country is gradually being depopulated. The results we see in the increasing difficulties which the town authorities find in dealing with the water and sewage questions, and in the increasing mass of vehicular street traffic, which makes some of our cities veritable pandemoniums. Luckily it seems that we are likely through the skill and energy of our engineers to meet these difficulties in more than one way. The cycle, which commenced as an amusement and went on as a fashionable craze, has now settled down into being the poor man's horse. The number of our working population that use the cycle for going to and from their work is already very large and is steadily increasing, and their use of the roads must be considered. Then came the motor-car, developed in France to such an amazing extent, and which seems now likely to be developed to an equal extent in this country. After many years of objecting to the use of the overhead trolley system, our town authorities seem now to have determined that the only way of relieving street traffic is by an enormous development of electrical tramways, and on all sides we find the large towns rivaling one another in the extent of the tramway systems which they have either acquired or are laying down for themselves. It seems opportune now to point out that a great deal of mischief may accrue by this indiscriminate use of tramways, and for those who are considering these matters I bring forward a few facts which are worthy of notice. Of course, in new countries, or in new towns in old countries, where the roads are rough and bad, anything in the nature of a tramway using rails is an improvement on a roadway; but when we are dealing with cities which already possess well laid out and well paved streets on which all kinds of wheel traffic can be carried on with a minimum of rolling resistance, it seems wrong from an engineering point of view to break up the surface of these streets for the purpose of laying tramways, and for the following reasons: Traffic carried on a roadway by vehicles, whether horse-drawn or by cycle or motor-car, differs from traffic carried on rails chiefly in that the former vehicles possess an important power, viz., that of *overtaking*, which is not possessed by the latter, that is to say, that vehicles on the plain road surface can overtake a stopping or a slower vehicle going in the same direction without interfering with other vehicles, whereas on rails the vehicles going one way must always remain in the same relation to one another, so that the speed of vehicles on rails must always be regulated by that of other vehicles going in the same direction. Street tramways, for instance, must stop to set down and take up passengers. This limits the speed average and the number of vehicles per mile of track, for if there be not sufficient intervals between the vehicles they would have to stop and start nearly simultaneously. Thus the carrying capacity of the best modern electrical tramway is limited by this want of overtaking power. I have made careful inquiry from those who have great experience in tramways, not only in this country, but in America, and on the Continent, and I find that it is generally admitted that the maximum carrying capacity of an electrical tramway in one direction is 4,000 passengers per hour carried past any given point. I find that a full-gage suburban or metropolitan railway crowded to its fullest extent cannot carry more than 12,000 passengers per hour. Now most of us have often seen large crowds taken away from a point of attraction by omnibuses and horse-drawn vehicles, and have noticed that the crowded omnibuses almost touch one another and yet can go at a fair rate of speed. In this case at eight miles per hour speed 14,000 passengers can be carried from a given point per hour.

Up to the present a public motor car service has not yet been installed of any magnitude to enable us to compare the carrying capacity of motor cars with that of horse-drawn omnibuses, but owing to the reduced length of motor-cars compared with that of omnibuses, and on account of their greater speed and greater control, motor-cars can be built to deal with great crowds at an even higher rate per hour than that noted above. It appears certain, therefore, that although the provision of electrical tramways is undoubtedly an economical means of carrying passengers, yet that these tramways cannot be laid in existing thoroughfares without considerably reducing the total road carrying capacity at times of heavy pressure of traffic, and as it appears likely that either for the daily transport of the workers to and from their homes to places of employment, or for taking great crowds out into the country for pleasure purposes, a motor-car service carried out on well-made roads will compete favorably with, and in many ways may be preferable to, tramway service.

It must be remembered that the laying of tram rails not only blocks ordinary traffic, but in our most crowded streets it introduces dangers to all wheeled vehicles not on rails, motor-cars, and cyclists by the skidding of the wheels when they cross the line of rails, and these dangers are daily causing, and are still likely to cause, very serious accidents.

The increased road and street traffic and the development of new means of road locomotion have made imperative some modification of our existing system of roadway administration. Cycles, motor-cars, electrical tramcars, have been invented and put on roads which are maintained and worked exactly as they were seventy years ago at the commencement of the railway era, when the population of the United Kingdom was half its present figure, and that of the large towns one-tenth of the present figure. During the 150 years previous to the railway era the ancient tracks were gradually improved into tolerably efficient roads for coach and wagon traffic, but after the introduction of railways there was a complete cessation of improvement, as for fifty years after the railways started the old roads were equal to the farmers' and local traffic which the railways left for them; but for the last twenty years the roads near to the great towns have been inadequate, and now that the cyclist and motor-carist travel over the whole of the roads of the country the neglect of our ancient roadway system is very apparent.

Although the urban population have so greatly increased, the old coaching roads are still the only ones that exist; no main roads parallel to the old ones or alternative to them have ever been made. Towns which are now joined by railways grew out of small rows of houses built facing the main road; in fact, in many cases the road made the town. During the early part of the railway era, when the roads were so little used from coaching falling into disuse, encroachments on the roadway took place in and near the towns, such roads being now actually narrower and less suitable for traffic than in the coaching days: so that these towns which owe their existence to these roadways now put every impediment and hindrance to their use by the traveling public. What is needed is that towns situated on our main through roads should provide alternative routes, so that through travelers could, if they desired, avoid the crowded streets of the town. One method of providing such relief roads would be by by-laws providing that all building estates should set aside land for main roads. The building estates which are developed around our great towns never provide a road which can be used as a main line of thoroughfare, although by their very act of building additional houses they cause additional congestion to the main roads. They lay out their roads to obtain quiet for those who live on the estate, and take every possible means to prevent their estate roads from taking a share of the main thoroughfare traffic.

Parliament must take in hand an improved administration of our highways by a comprehensive scheme. Far too many ancient main lines of thoroughfare, already too narrow for the traffic which is on them, are being blocked by having tramways laid on them; these cause the development of building estates, which throw additional traffic onto these thoroughfares. Apart from the roads themselves, the complicated conditions of street and road traffic demand careful regulation. Street traffic should be carried so far as possible by lines of vehicles driven as nearly parallel to one another as possible. The rule of the road, as it is called, and which is embodied in an Act of Parliament, 5 and 6 of William IV., which is commonly called the Highways Act, says that every vehicle is to keep as close as possible to the left, or near side of the road, except when overtaking another vehicle going in the same direction, and then it is to keep to the off side of the overtaken vehicle as closely as possible. As a matter of fact, everybody knows that this rule is habitually neglected by drivers who, whenever they get a chance, drive down the center of the road, so that others who overtake them dare not do so on the wrong or near side, but must pass out far to the off side of the road, and consequently interfere with the traffic coming in the opposite direction. This neglect of the rule of the road causes a great waste of space immediately behind every vehicle, and is one of the chief causes of the limited carrying capacity of the streets in cities where the police do not attend to this important matter. It can be remedied by the existing police regulations being adhered to and insisted on by fixed-point constables, or by constables moving about on motor-cars or bicycles. Slow moving and frequently stopping vehicles are another cause of congested traffic. A great deal might be done by arranging that during certain hours much of the slower moving traffic is shunted into alternative routes, so as to be kept by itself. An increase in the speed of the street traffic is desirable; for the faster the vehicles travel the less the street is occupied by them. Motor-cars can safely travel at sixteen miles an hour, and, therefore, need only take half the time and occupy only half the street surface that an omnibus does when traveling at eight miles per hour. Such high speeds as these, which are desirable and perfectly safe for motor cars, cannot, however, be obtained unless some regulations are made as to the use of the roadways by foot passengers. There is no rule of the road for foot passengers—they pass one another on the footpath, or vehicles in the roadway, just as they please. No driver of a vehicle in the road who sees a foot passenger stepping into the roadway can ever tell with certainty what his movements will be. It will be no hardship to foot passengers to insist on their movements being regulated.

Much has been recently said and written on the subject of motor-cars and motor-wagons. It is generally admitted that there will be considerable scope for engineering skill and capital in their improvement and construction. It is by no means an easy problem to put into the hands of the public such a complicated piece of mechanism as a self-propelled carriage which has in most cases to be managed and driven by men who have had no special mechanical training. Motor-cars to be universally successful must be made so as to reduce to a minimum the liability to break down; repairs must be limited to the replacement of worn or damaged parts by other parts, which must be supplied by the manufacturers so that they can be readily put in by the unskilled users. That this can be done is shown by the success and universal use of typewriters, sewing machines, and bicycles: all of these are really complicated pieces of mechanism, but which are now in such general use and in everyone's hands. In these cases, however, the organized manufacture of machines with thoroughly interchangeable parts, or components as it is the fashion to call them, has only been developed after the type of machine had settled down, and this up to the present cannot be said of the motor-car or motor-wagon. Up to the present the development of these cars has gone on on several lines. The development in France, which so far has led the world, has been principally in the direction of the use of light motors driven by petrol spirit. Again to France we owe the flash boiler of Serpollet, which assists the use of steam engines for this purpose.

At first sight steam, with the complications of boiler, engine, and condenser, does not appear likely to compete favorably with the simpler spirit motor, but for heavier vehicles, where steady heavy pulling power is of importance, up to the present no internal combustion motor has competed with it. The Americans, with their usual skill and power of rapidly organizing a new manufacture, have already turned out a very large number of steam-driven motor-cars, which are so largely in use in unskilled hands that it shows that they have already solved the problem to some extent.

The directions in which the two classes of motors require further development are, for the internal combustion motors, the satisfactory and inodorous use of the heavier oils, and in this perhaps Herr Diesel may help us with his wonderfully economical motor improvements in the clutch mechanism, for with all internal combustion engines up to the present it has been found impossible to start the motor when coupled to the driving-wheels of the car; and in the case of the steam motor the simplification of the boiler, the boiler feed mechanism, the inodorous and noiseless burning of heavy oils as fuel, improved condensers, methods of lubricating the pistons and valves so as to avoid oil passing back to the boiler with the condensed water, and the rendering of all processes of boiler feed and fuel feed mechanism completely automatic so as not to require the attention of the driver. On points common to both classes, although much has been done, further improvement is required in the methods of transmitting the power from the motor to the driving-wheels. In the case of the steam cars, where this has been done by single reduction, using chain, pinion, and sprocket, very efficient and noiseless transmission has already been obtained, but up to the present in most of the internal combustion engines where more than two cylinders have to be employed, it has been found necessary to arrange the crank shaft of the motor at right angles to the axle of the driving-wheels, so that part of the transmission having to be through bevel gear, this part has up to the present always been noisy. In the providing of noiseless and efficient chain driving, the manufacture of cars has gained greatly by the high degree of perfection to which these chains had already attained for bicycle work.

The recent great road races which have taken place in France and elsewhere have shown that the motor-car can be driven safely at a very high speed, already reaching in some cases seventy miles an hour; but to render this capacity for high speed useful, not only must special roads be provided on which these high-speed cars can travel without danger to others and with least slip and wear and tear of tires, but a great deal requires to be done in the improvement of the pneumatic tires, which at present get excessively hot, and therefore damaged by these high-speed runs. At these high speeds the mechanical work done on the material of which the outer covers of pneumatic tires are composed is excessively high. It can probably be reduced by increasing the diameter of the wheels, but, of course, at the cost of increased weight and, to some extent, of stability, for the side strains on the wheels of these cars when swinging round curves of sharp radius are very great.

Another direction in which mechanical invention is required for the wheels of motor cars and wagons is a shoeing or protection of hard material of easily renewable character which can be firmly and safely attached to the outside of the tire covers to take the wear and cutting action caused by the driving strain and by the action of the breaks on sudden stops.

The late R. W. Thomson, of Edinburgh, made good progress some thirty years ago in providing steel shoeing for the solid rubber tires he then used, and the problems of providing the same for pneumatic tires ought to be no harder than those he then successfully encountered.

One of the topics which has been most strongly discussed during the last year has been the position which this country holds relatively to other countries as regards its commercial supremacy in engineering matters. A few years back we were undoubtedly ahead of the world in most branches of mechanical engineering, but owing to the huge development of mechanical engineering in America and Germany, we are certainly being run very hard by these countries, and everyone is looking for means to help us to regain our old position. In endeavoring to learn from America we see that, although the workmen in that country receive higher wages than they do here, and although the cost of some of the materials is higher than it is here, their manufacturers manage to deliver engines, tools, and machinery of all classes of excellent quality at a price which appears to our manufacturers to be marvelously low. When we look into the matter we find that the chief difference between the manufacturer of America and the manufacturer at home is that, whether it be steam-engines, tools, agricultural machinery, or electrical machinery, the American invariably manufactures goods in large quantities to standard patterns, whereas we rarely do so here, at any rate to the same extent. Where we turn out articles by the dozen the Americans turn them out by the hundred. This difference in the extent to which an article is reduplicated is caused by the Americans having realized to a far greater extent than we have the advantage of standardization of types of machinery. They have felt this so strongly that we find in America that work is far more specialized than it is here, so that a manufacturer as a rule provides himself with a complete outfit of machinery to turn out large numbers of one article. He lavishes his expenditure on special machinery to produce every part sufficiently accurate to dimension to secure thorough interchangeability; consequently the cost of erecting or assembling the parts is far less than it is here. One reason why the American manufacturer has been able

to impose on his purchasing public his own standard types, whereas we have not been able to do so, is that very rarely in America does a consulting engineer come between the manufacturer and the user, whereas here it is the fashion for the majority of purchasers of machinery to engage a consulting engineer to specify and inspect any machinery of importance. By this I do not impute any blame to our consulting engineer; he considers the requirements of his client, and insists that they are to be adhered to as closely as possible; to him the facility of the production of articles in large quantities is of no moment. In America it seems to be understood by the purchaser that it is a distinct advantage to everyone concerned, both manufacturer and purchaser, that the purchaser should to some extent give way and modify his requirements so as to conform with the standard patterns turned out by the manufacturer. Although manufacturers all hope for this simplification of patterns, yet, for the reasons I have given, it will be some time before their hope is realized. But on other matters it is quite possible for manufacturers to combine, so as to obtain some standardization of parts which they manufacture which will reduce costs and be of advantage to everyone concerned. Many years ago Sir Joseph Whitworth impressed on the world the importance in mechanical engineering of extreme accuracy, and of securing the accurate fit and interchangeability of parts by standard gages. But in spite of his idea being so widely known and taught, how seldom it has been acted upon to the extent that it should be. We pride ourselves on having all our screws made of Whitworth standard, and yet how many of the standard bolts and nuts made by different makers fit one another? I myself have sat on a committee of this Association which was called together twenty years ago, with Sir Joseph Whitworth as a member of it, to fix on a screw gage which would be a satisfactory continuation of the Whitworth screw gage down to the smallest size of screw used by watchmakers. It has taken all these years to carry out the logical outcome of Sir Joseph Whitworth's original idea, viz., the providing of standards to be deposited in care of a public authority to act as standard gages of reference. The complete interchangeability of parts which I have above referred to, and which is so desirable in modern machinery, can, of course, be obtained within the limits of one works by that works providing and maintaining its own standards to a sufficient degree of accuracy. But if the articles be such as watches or bicycles, motor cars, etc., it is very desirable that all parts liable to require replacement should be made by all manufacturers to one standard of size, and in order that the gages required for this purpose should all be exact copies of one another it is necessary that they should be referable to gages deposited either with the Board of Trade or with some body specially fitted to verify them and maintain their accuracy.

Up to the present the Board of Trade has dealt with the simple standards of weight, capacity, and length, but in other countries National Standardizing Laboratories have been provided, viz., by the Germans at their Reichsanstalt at Charlottenburg, and with the happiest results; here at last, through the exertion of the Council of the Royal Society, our government has been moved to give a grant in aid and to co-operate with the Royal Society to establish a National Physical Laboratory for this country. About ten years ago Dr. Oliver Lodge gave the outlines of a scheme of work for such an institution. Later Sir Douglas Galton, in his Presidential Address to this Association, called attention to the good work done by the Germans and the crying need that existed for such an institution in this country. The matter has since progressed. A laboratory is already in existence, and will soon be at work, at Bushey House, Teddington; it is a large residence, which was once occupied by the late Duke of Clarence and afterward by the Duc de Nemours. It will make an admirable laboratory, as it has large and lofty rooms and a vaulted basement in which work can be carried on where it is important to secure the observer against changes of temperature.

The aims of a National Physical Laboratory have been well put forward by Dr. Glazebrook in a recent lecture at the Royal Institution, in which he points out how little science has up to the present come to be regarded as a commercial factor in our commercial world. The position of manufacturers of all classes must be helped and improved by a well-considered series of investigations on the properties of materials, measurements of forces, and by the careful standardization of and granting certificates to measuring apparatus of all classes. Until the question is fairly faced and studied, few manufacturers realize how helpless individual effort or individual investigations must be when compared with comprehensive and continuous investigations which can be carried on by a National Laboratory so as to deal with the whole of each subject completely and exhaustively instead of each investigation being limited by the temporary need of each manufacturer or user.

As an example Dr. Glazebrook showed how much has been done at Jena and afterward at the Reichsanstalt in the development of the manufacture of glass used in all classes of scientific apparatus. The German glass trade has benefited enormously from these investigations. The microscopic examination of metals, which was begun by Sorby in 1864, has been much worked at by individual investigators in this country, but its further development, which is probably of enormous importance to arts and manufactures, is clearly the duty of a National Laboratory. We owe much to the investigations of the Alloys Research Committee of the Institution of Mechanical Engineers; but, again, this is work for the National Laboratory. As regards the measurement of physical forces how little is accurately known of the laws governing all resistance and wind-pressure, and the means of measuring them. Who can formulate with any certainty a law for the air resistance likely to be met with at speeds in excess of eighty miles an hour, the importance of which I have already noticed?

I have already alluded to the verification, care, and maintenance of ordinary standard gages of accuracy. In this electrical age the accuracy of electric standards is of supreme importance.

These are only a few of the directions in which we can foresee that the establishment of a National Physical Laboratory will be of the greatest use and assistance to our country in enabling it to hold its own in scientific and engineering matters with its energetic rivals. The work has been commenced on a small scale, but it is to be hoped that its usefulness will become at once so evident and appreciated that it will soon be developed so as to be worthy of our country.

IMPROVISED BOOSTERS.

By WALTER M. HOLLIS.

IT is safe to say that at some period of the growth of nearly all the smaller electric railways it has been found on extending some of the longer lines that trouble was experienced in operating the cars upon the regular schedule. The report from the motormen may be simply that they were unable to make time because the car would not speed up, or a more serious turn may be given to the matter by the condition of the motors. The inspector may discover motors badly overheated and charred, or, what is very likely to be the case, motors may burn out on the road with unusual frequency. This may occur when cars are operated on the regular schedule, or may not appear until some special occasion calls a larger number of cars into use near the end of the line.

Upon investigation it is usually discovered that the trouble is due to low voltage caused by excessive drop in the line. The next thing to do is to see what the drop really is. By keeping the station voltage as steady as possible for a time and running a car provided with a voltmeter connected between trolley and ground, at the end of the line, the difference in voltage is speedily found. In order to get a complete and exact knowledge of the conditions, it will be well to try this under various conditions, that is, with one car started slowly and then quickly, and then with several cars together in such combinations as are likely to occur in practice.

At this time (if the figures are not already at hand) tests should be made to determine what current the cars will take at normal voltage, under the conditions likely to obtain at the end of the line under consideration; that is, supply a car (which is in good condition) with a voltmeter and an ammeter and take readings at normal voltages while the car is run under similar conditions as to track and grades to those on the line. This, of course, is a rather rough method, but it will serve in this case. Having obtained these values, and knowing from the schedule the number and positions of the cars at various points at different times on this extended section, a very good prediction may be made as to the current necessary for these cars, at or near normal voltage.

Now, in a case like this there are at least three resources for solving the difficulty (an additional station, storage batteries, or alternating transmission being out of the question). First, additional feeder wire; second, a booster in the present feeders; third, a combination of these two. The scope of the present article is not great enough to include the many questions which decide, under given conditions, whether or not a booster shall be installed; it is assumed herein that the conditions are such that a booster is the best way out of the difficulty. The third method, then, will be discussed—the use of a booster and an additional feeder.

Assume that the particular branch under consideration extends from the station for a distance of about nine miles, and the heaviest load is well out toward the end; suppose that this load amounts to about 150 amperes at its maximum. (This 150 amperes is calculated from the value known to be used by cars under the given conditions at normal voltage, combined with a study of the schedule, which latter shows the positions of the cars at any particular time and place.) Suppose that a further study of the conditions, including the allowable cost of additional feeder wire, shows that a drop of about 300 volts, with 150 amperes flowing, is the value to be used. As this 150 amperes is maximum value for regular running conditions, and not the average value, the actual all-day loss in the line is not so great as might appear at first sight. With 550 volts at the station and a drop in the line of 300 volts, a "boost" of 300 volts will obviously be required to give 550 volts at the end of the feeder. A "boost" of 300 volts, with 150 amperes flowing, means a booster ratio of 2 to 1.

Consider somewhat in detail the conditions under which a series booster operates. The entire feeder current flows through the field as well as the armature, and supplies the entire field excitation. The current in the feeder, and consequently in the field, varies between zero and 150 amperes. Now, so long as we keep below the bend in the excitation curve, or before the field magnet core becomes saturated, the ratio of field strength to amperes, and hence of volts to amperes, remains constant. This, however, is not of strict importance, so long as we know about what to expect and do not go too far beyond. As is easily seen, this means a field range from about zero nearly to saturation, and it might appear that trouble would be experienced due to sparking, etc.

In designing a shunt or a compound-wound machine, the question of sparking depends upon: the volts per commutator bar, the field strength, the armature reactive ampere-turns, and the inductance of the short-circuited armature coils; in such a machine a range of field strength such as that mentioned would clearly be impossible. In a series booster the conditions are something like this: Starting with a 300-volt "boost" at 150 amperes, the machine runs all right, sparklessly. If, now, the current drops to one-half, 75 amperes, the field strength, and consequently the voltage of the "boost," are halved. This cuts in two the volts per commutator bar, so that the field is now able to reverse the current in the armature coils between adjacent commutator bars under precisely similar conditions as heretofore. This is the case all the way up and down the voltage variation.

As the field and armature are in series, the armature back ampere-turns that react upon the field vary in just the same proportion as the field ampere-turns, and there is at all times, within the limits set, a balance of forces. In the case of a very sudden increase of current there will be a tendency toward sparking, more especially if the field poles and cores are massive, as then there is likely to be some sluggishness in the change in the field strength and for a moment the armature reaction may weaken the field and so cause sparking.

At the present time boosters of all sorts, kinds and descriptions may be bought ready made, or made to order for a consideration, but this was not always so, and even now an improvised booster may be made up that will give entire satisfaction and cost less. Some stations may be so fortunate as to have an old-style smooth-core or gramme-ring generator, already operating with newer machines or kept as a spare, as is the case in many installations. Now, a machine of this type can be very readily and economically changed into a booster. It is safe to say that the machine is belt-driven. For this particular case a machine of about 40 to 50 kilowatts capacity will be required. The following points must be ascertained at the outset: (1) Turns on each field spool (ascertained from the manufacturer or by actual count); (2) ampere-turns of field at full load (field current multiplied by turns); (3) ampere-turns of field which give the bend in the saturation curve. In order to ascertain the field ampere-turns required at the point where the saturation curve bends most sharply, proceed as follows:

Run the machine at normal speed with the armature open-circuited, and measure the volts at the brushes and the amperes in the field. Start with a strong field, decreasing gradually and taking reading at intervals on the instruments until a low reading is reached. Then break the field entirely and start in again with a weak field, gradually increasing and taking readings as before, until the preceding high values are reached. If these values are plotted with armature volts vertically and field ampere-turns horizontally, the bend in the curve, or the point where the field approaches saturation, is very easily seen. Care should be taken when decreasing the field strength to keep going down and never return to a point, and *vice versa* when coming up the curve. The curves will doubtless come fairly near together and a mean value can be taken. The ampere-turns corresponding with the bend of the curve should be taken as the maximum value of the field ampere-turns in rewinding the booster, although a large leeway is allowable if by that means it will be better for the other factors, as for instance, the winding of the armature. In this particular case the value of the ampere-turns obtained from the curve, divided by 150, will give the number of turns for each pole of the booster.

Next ascertain (4) the armature turns in series between brushes (obtain from manufacturer or by inspection); (5) normal revolutions per minute (probably on name plate); (6) maximum allowable brush contact on commutator (by inspection; the increased current will doubtless require more brush-bearing surface, and even if a commutator of the same number of segments is used greater width will be necessary. A new commutator may be required).

In the case assumed, if the other conditions are favorable (as will be discussed later), the turns on the armature in series will be for the booster about 300/500 of what they were before, the machine having been originally wound for 500 volts. There are so many types of machines which might be adapted in this way that only general advice can be given; but in many cases the entire work can be performed by a regular employé, although a skilled armature winder will be required. The voltage of a dynamo depends upon the speed, S; the strength of the field, F, and the turns in series on the armature. By varying any of these quantities we vary the voltage, or the "boost" in this case, by a proportional amount. So that here, within considerable limits, the speed of the machine may be varied and this may help out in the armature winding. That is to say, the maximum strength of the field is fixed by the original design of the machine; the maximum volts "boost" is fixed by the conditions first determined; hence, the product of revolutions per minute and turns in series on the armature must equal a certain value. They may, however, be varied between themselves, which may give some leeway in winding the armature. Below the field maximum there is also a considerable range, and all of the above quantities can be varied (subject to the above conditions) to favor the winding of the armature.

The rewinding of the field is very easily done; the coils may be of copper ribbon or simply flexible cable coiled on, depending, of course, upon the machine. If a flexible cable is used, a rough way of getting the proper field would be to simply wind on what is known from previous tests to be an excessive number of turns and then measure the "boost" with full load on the machine. Turns could then be taken off until the proper voltage was obtained. This applies more particularly to a bipolar machine where the cable could be easily handled.

It sometimes happens after a booster is installed, that a change is required in the ratio of volts to amperes. There may be a change in the regular load conditions on the feeder, or it may be desired to switch the booster to some other feeder. Within certain limits this is easily accomplished, if the desire is to lessen this ratio, by putting a resistance in parallel with the field, shunting part of the current. It will be found very convenient to have this shunt box made up with several steps in it, so that a change of ratio can be very readily obtained.

Knowing the field resistance, the present maximum ampere-turns on the field, and the corresponding maximum volts "boost" and amperes, the resistance for the shunt box can be easily calculated.

The first ratio is $\dfrac{300 \text{ volts}}{150 \text{ amperes}} = 2$; say the desired ratio is $\dfrac{200 \text{ volts}}{150 \text{ amperes}} = 1.33$.

Now, as shown above, the volts supplied by the booster depend directly upon the field strength or ampere-turns, other things being constant. So we reduce the ampere-turns on the field according to the above ratio. If the first ampere-turns are represented by A, then the second ampere-turns will be equal to $A \times \dfrac{1.33}{2.00} = 2/3\ A$, and if the field resistance be repre-

sented by R then the shunt-box resistance will be equal to $2R$, according to the principle of divided circuits.

As shown above, if this weakens the field too much, so as to entail sparking, a lowering of the speed may be resorted to instead. It should be kept clearly in mind that nearly all the essential points have considerable allowable margins on both sides. These limits can be determined by experiment and observed in changing the machine. In rewinding the armature a liberal policy should be followed as to radiating surface and size of wire for the increased current.—American Electrician.

THE EHRARDT CAMPAIGN GUN.

It was hardly four years ago that the campaign artillery of the German army was provided with what was called an accelerated fire gun, which it is now thinking of discarding in favor of other pieces of a more modern model, that is to say, of rapid fire. It must be said also that the gun with which the French army has recently been provided leaves that of the Germans far behind it. A few figures will suffice to show the disparity that exists between the two weapons. That of the Germans is capable of firing but eight shots a minute at a maximum, while that of the French is capable of firing twenty-four in the same time. A single one of the French guns is therefore of as much avail as three of the German.

So, at the great maneuvers of the present year, the German army is going to try a new gun devised by the Ehrardt establishment, and the principle and arrangements of which appear to be close imitations of those of the piece now in use in the French army.

The following are the data that we have been able to obtain on the subject of this weapon: The Ehrardt gun is a rapid-fire one, of a caliber of 3 inches. With its carriage, it weighs 1,980 pounds, and, with the fore carriage, 3,520. Such extreme lightness, which is indispensable for a campaign piece, is obtained through the use of steel tubes for the pole of the carriage, the fellies and the spokes, and just the number of rivets necessary.

The gun is of Ehrardt steel, a metal that has the property of presenting a great resistance. The closing of the breech, for which the house has no preference, may be done by screw, wedge or eccentric of the Nordenfeldt system. We are credibly informed, however, that the German artillery has given preference to the wedge, because of the experience that its gunners have already had with this system. As in all rapid-fire guns, the opening and closing of the breech are effected in a single motion. The cocking of the piece constitutes one motion, as does that of the firing, which is effected by means of a lanyard. The gun is capable of imparting to a 143-pound projectile an initial velocity of 1,640 feet. It seems that this is the limit that all campaign guns have reached, and it is to be remarked that such velocity is just the same as that formerly attained by smooth-bore guns. It must be observed, however, that the old round balls were relatively lighter than the cylindro-ogival projectiles of the present time.

The carriage consists of an upper part called a cradle, which is formed of a U-shaped seamless tube, and in the interior of which is situated the brake, and of two carriages supporting the barrel and capable of sliding upon the cradle. The latter is connected with the carriage, properly so called, through a pivot, so that it can take on a lateral motion permitting of the rectification of the direct fire without its being necessary to displace the carriage.

FIG. 1.—THE EHRARDT RAPID-FIRE CAMPAIGN GUN OF 3-INCH CALIBER.

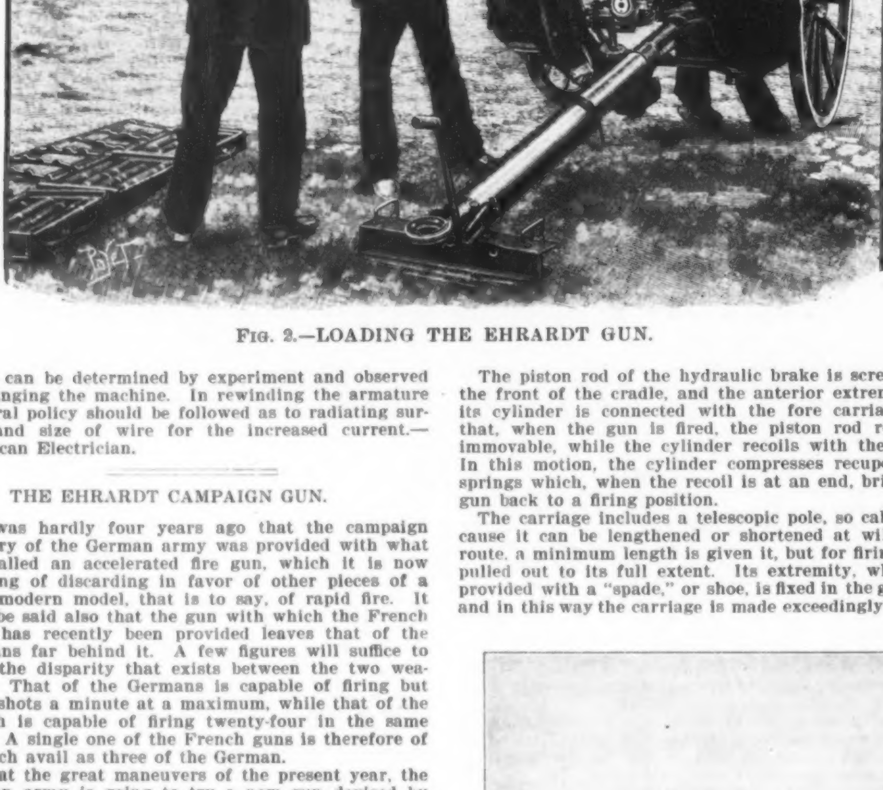


FIG. 2.—LOADING THE EHRARDT GUN.

The piston rod of the hydraulic brake is screwed to the front of the cradle, and the anterior extremity of its cylinder is connected with the fore carriage; so that, when the gun is fired, the piston rod remains immovable, while the cylinder recoils with the piece. In this motion, the cylinder compresses recuperating springs which, when the recoil is at an end, bring the gun back to a firing position.

The carriage includes a telescopic pole, so called because it can be lengthened or shortened at will. En route, a minimum length is given it, but for firing it is pulled out to its full extent. Its extremity, which is provided with a "spade," or shoe, is fixed in the ground, and in this way the carriage is made exceedingly stable.

It may be seen from what we have said that the pointing has scarcely any chance of being modified. The pointer confines himself to effecting the few slight variations necessary by means of a hand wheel placed within his reach. Upon the whole, the quickness of firing depends only upon the time necessary for the piece to recoil and return to battery, since, with skillful gunners, it is easy to charge the gun almost completely while it is in motion. It is possible to fire from 15 to 20 shots a minute. In front of the weapon may be fixed a steel shield for protecting the gun squad from infantry balls.

The gun is loaded with a metal cartridge containing the powder and supporting the projectile. The cases are of steel or brass. The powder, which has nitroglycerine for a base, is smokeless.

The projectiles are of three kinds: (1) a ball or shrapnel shell of iron plate with a rear charge and an extra light fuse of aluminium, and containing 300 balls, each weighing 165 grains. When the fuse communicates fire to the internal charge, the latter simply drives the ball forward without rending the jacket. The result for the balls is an increase of velocity of about 165 feet. The maximum duration of the fuse is 21 seconds, corresponding to a range of 19,680 feet for an initial velocity of 1,640.

(2) A thick-walled, high explosive shell containing a powerful explosive charge analogous to French melinite. This shell, which acts only through its fragments, is designed to be fired solely at wide angles in order to reach an enemy behind his intrenchments.

(3) A torpedo shell, which is elongated and has thin walls, so that it can contain as heavy a charge as possible of a powerful explosive. It is employed for destroying intrenchments and all objects that offer a resistance.—For the above particulars and the engravings we are indebted to La Nature.

THE SEWERS OF ANCIENT ROME.

The early cloacæ or sewers of Rome appear to have been the work of the Greek Tarquinius Priscus. They drained every street of Rome and were works of great magnitude. It was the construction of these and later sewers that made many valleys in Rome, originally mere marshes interspersed with pools of water, into dry and habitable ground, and thus contributed very largely to the growth and prosperity of the city. These great drains must have been constantly flushed and kept clean, for they carried not only the sewage of the city, but also the water of a number of natural springs. An enormous flood of pure water was constantly poured into Rome by the great aqueducts. The largest of these drains was big enough for a loaded hay cart to drive up a considerable distance. In addition to the waters referred to there were also many small streams to be provided for. Their banks appeared to have been lined with great blocks of stone, leaving a channel some 5 feet wide so as to prevent the spreading and the wandering of the flood water, but no attempt appears to have been made to straighten or shorten the streams. The Cloaca Maxima was very irregular in its path and does not resemble a drain built by Etruscan engineers. Lanciani claims that the Roman cloacæ have been overpraised. It is certainly a marvelous fact that they were still in use a few years ago after a lapse of twenty-six centuries. They bid defiance, however, to modern sanitary principles. In the first place they served to carry off sewage and the rain water together, making it necessary to have large openings along the street, exposing the inhabitants to the dangers of sewer gases. Then they all emptied into the Tiber, polluting waters that were used not only for bathing, but also for drinking purposes. The latrines of the Roman houses were placed next to the kitchen and the same drain was used for the sinks. Against such menaces to health the Romans had only the hilly nature of the ground and their abundant water supply which kept all drains constantly flushed. In the many hundred antique drains discovered in Lanciani's time, he never saw a sign of communication with the houses lining the streets through which the drains passed. All the side

MOUTH OF THE CLOACA MAXIMA, ROME.

channels which emptied into the Cloaca Maxima belonged to streets or public buildings, none to private dwellings. This fact would lead us to suppose that these pools were more popular than communications direct with the public sewer; still only one has been discovered in all the excavations.

The Cloaca Maxima was about 10 feet 6 inches wide and about 14 feet high to the crown of the vault. Its floor was paved with polygonal blocks of lava like a Roman street. Along parts of its course the stone vault has been replaced in Imperial times with one of concrete. It has its exit in the quay wall which lines the river bank by the Forum Boarium. At this point its arch, which is nearly 11 feet wide and more than 12 feet high, is formed of three rings of peperino voussoirs, as is clearly shown in our engraving. In 1890 a large piece of Cloaca Maxima, nearly 700 feet long, was cleared out and can now be visited without difficulty. Numbers of fish attracted by the offal in the drain appeared to have penetrated up the Cloaca a long distance from the exit of the Tiber and to have been caught and eaten by the poorer classes of Rome.

There is some reason for believing that the idea of building the great arched cloaca was derived, like most of the early Roman architecture, from the partly Hellenized Etruscans.

PRUNES AND PRUNE CULTURE IN WESTERN EUROPE, WITH SPECIAL REFERENCE TO EXISTING CONDITIONS IN THE PACIFIC NORTHWEST.*

THE prune industry of France is about a thousand years old, and with a few exceptions due to the recent introduction of modern commercial evaporation and packing plants, it is carried on in much the same way to-day, so far as the producer is concerned, as it was four hundred or more years ago. While the industry is less than a half century old in America, and great changes have been made in the methods of producing the cured product, French methods have remained practically unchanged for centuries.

To the person familiar with the Pacific Coast orchard areas, France offers a very disappointing field for orchard study. Her orchards would be called, more properly, fruit gardens. As such, of course they are extremely interesting and fraught with lessons to the American horticulturist. While it is true that one finds an occasional small area planted to trees in the way that is common in western America, yet on the whole the orchards of France are composed of a mixture of plantations of fruit trees and shrubs, ornamental and other plants.

The chief part of the prunes of France are produced in the northern and eastern parts of the department of Lot et Garonne, a section of country approximately 2,000 square miles in extent, situated in the southwestern part of the country, about 45 miles from Bordeaux and nearly 60 miles from the Atlantic coast; in the northern and western parts of the department of Tarn et Garonne, which is somewhat smaller than the preceding department and lying just to the southeast of it; in the department of Gironde, which is the region surrounding Bordeaux; in the department of Deux-Sevres, a small section lying about 100 miles to the north of Bordeaux and 30 miles from the Atlantic coast; and in the central part of the department of Meurthe et Moselle, an irregular strip of country lying in the northeastern part of France adjacent to the German border and along the Moselle River. The prunes from this latter section are of the "quetsche" type as distinguished from the Agen, or *D'Ente*, which is the common type in the former regions. Several other departments also produce unimportant quantities of this fruit. The department of Lot et Garonne produces nearly one-half of the total output of France, which for the year 1900 was approximately 100,000,000 pounds, selling for an average of 4 cents per pound, all sizes. The same year the output of Agen prunes from California was about 130,000,000 pounds, selling for 3 cents per pound on the same basis as in France, while the output for the Pacific Northwest was probably not far from 7,000,000 pounds of Italian, selling for $4\frac{1}{2}$ cents per pound, all sizes, and of Agen, about 5,000,000 pounds, selling for 3 cents per pound, all sizes.

The chief prune-growing sections of Germany are the provinces of Baden, Elsass, Lothringen, and the Kingdom of Saxony. This latter region extends into Bohemia along the Elbe River and its tributaries from a point near Tetschen to Leitmeritz, a distance of 30 miles, more or less, and extending over a belt of country probably not less than 15 miles wide on the average, with occasional stretches extending farther. The Bohemian section of this district is of much more commercial importance than the Saxon section.

AN ORCHARD OF ITALIAN PRUNE, NINE YEARS OLD, FREIBURG, BADEN, GERMANY.

ORCHARD METHODS.

In Bohemia are to be seen thousands of acres of prune orchards planted on the same general plan as our American orchards, with these differences: There are no large individual or corporate plantings, and prune trees are freely planted along the highways, lanes, boundary lines, and about the buildings as well as in orchards. An occasional single orchard block may contain 20 acres, and while this may appear quite insignificant to the large orchardist of the Pacific Coast, it is very different from the French type of prune orchard, which is generally a very irregular and mixed plantation of fruit-bearing trees, shrubs, vines, and other plants.

With the exception of a quite limited region about Sainte Livrade and Villeneuve-sur-Lot, and an irregular and broken section in eastern France between the Meuse and Moselle Rivers, the prune orchards of France are not planted in blocks or masses. The trees are set in rows, usually, though frequently there appears to be no attempt at regularity, and when in rows the rows are from 40 to 60 feet apart. Frequently three or four rows are planted side by side, the trees being approximately 16 to 20 feet apart each way. The zones or belts of rows are separated from one another by several rods of open field, and occasionally one such belt of rows, extending from one end of a field to the other or even from one end of the farm to the other, will be the full extent of the orchard plantation upon a given property. In the rows not only are prunes planted, but there may be cherries, apples, pears, peaches, quinces, bush fruits, grapes, nuts, osier willows, and an occasional ornamental tree. Between the rows of trees are grown the various cereal, forage and root crops, or in many instances the tract of open land is a meadow. Often an owner or renter will have a few trees in a certain locality and others widely separated from them. Not infrequently these different orchard plats are two or three miles apart.

The trees are never cultivated for themselves. Such tillage as the soil receives is given for the benefit of the field crops. It must not be inferred from this, however, that fruit trees are never cultivated in France. In the region surrounding Paris, where immense quantities of fruit, such as cherries, plums, pears, apples, and small fruits are grown, excellent tillage is given the soil, but in this region, where land is very valuable, trees are grown close together—6 to 8 feet apart usually—and the ground is literally covered with other crops. Or the tree crops may be scattered or in irregular groups, and no particular attention given them save to gather the fruit.

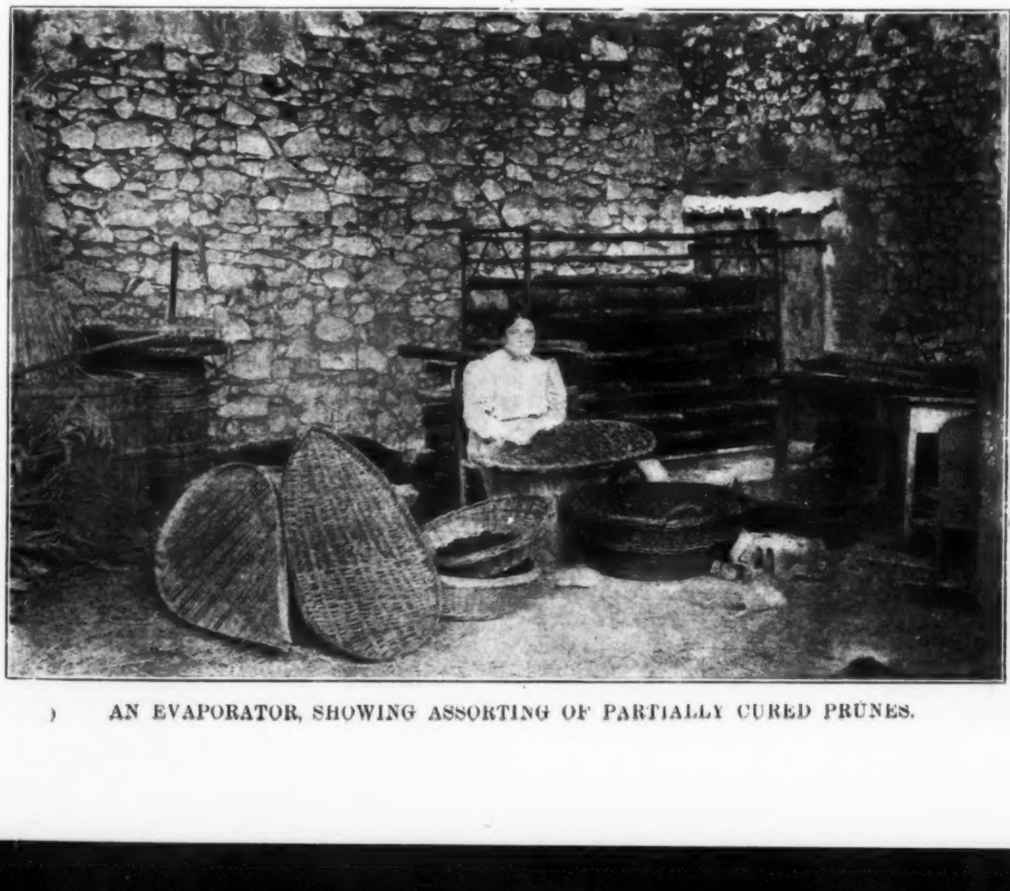
PRUNING AND TRAINING.

In Europe the universal practice is to train orchard trees with high heads, the object being to let the sun and air have free access to the ground in order that the cover crop may have ample opportunity for development. Usually the trees are headed at a height of from 4 to 5 feet. Little pruning is done, save to thin out and occasionally to cut back the young growth if the trees are grown on land that is irrigated. The heads are usually round to roundish, and generally much smaller than in the case of Pacific Coast trees of corresponding age. The plum tree lives to a good old age in Europe and frequently is of large size. In the "quetsche" growing sections of Germany and Austria the trees are somewhat larger than the Agen trees in France and approach the size of similar trees on the Pacific Coast, though the style of pruning and trimming is the same in all sections—i. e., with high heads. The Mirabelle is treated in the same manner, though trees of this variety often attain a size considerably above that of the Agen at a corresponding age, and the spread of top is relatively greater.

THE PRUNE IN COMMERCE.

Commercially considered, the evaporated prune is apparently not now held in as high esteem as it has been heretofore. The people of Europe prefer the plum preserved in jars, cans, or bottles, in one way or another, to the evaporated product, yet large quantities of dried prunes are consumed by the middle classes, for the reason that the prices of preserved and canned plums are beyond their means. The chief reason, perhaps, for the decline of the prune in public estimation in Europe is that its appearance upon the market is in nowise improved over what it was twenty-five years ago, while in the case of all other fruits there has been great improvement in both the style and character of packing and packages. In America the recent rapid improvement in fruit refrigeration has worked harm to the dried-fruit industry in that it makes it possible to materially lengthen the season during which fresh fruits of many kinds may be marketed at a price within the means of the well-to-do industrial classes, and thus the demand for evaporated fruit is perceptibly reduced on the part of those whose means would otherwise permit them to pay good prices for this product. It is safe to say, however, that the market for the evaporated prune will steadily increase if it can be supplied with a high quality of fruit, neatly and cleanly packed, which can be sold for a reasonable price. At present the poorer people of England, France and Germany consume little fruit, relatively speaking. These people have a constant struggle to obtain the necessaries of life, and as fruit is held by most of them to be something of a luxury it is only consumed when their means are in excess of the amount required for necessaries.

There is a steadily growing demand in foreign markets for pitted fruit, and an effort is being made by



AN EVAPORATOR, SHOWING ASSORTING OF PARTIALLY CURED PRUNES.

* By E. R. Lake. Condensed from Bulletin No. 10 Division of Pomology, U. S. Department of Agriculture.

some of the Austrian growers to meet this demand. It appears from a study of the situation that in the near future much of the better quality of prunes will be offered to consumers as "pitted plums;" especially does this appear to be the outlook for the Italian and other large varieties. Consumers do not care to buy pits. This part, which costs the producer most in the consumption of soil fertility, has no value in commerce, at least in its present form, and a demand is being made to have it eliminated from the product. This change in the character of the marketable product of the prune would necessarily involve great changes in the process of curing. There is reason to believe, however, that the invention of machinery for pitting will eventually reduce the work of that operation, which is at present quite impracticable.

SECONDARY PRODUCTS.

As in the American orchards, so in the orchards of France and Germany, there is a large quantity of second-grade fruit unfit for the evaporator, or even, after having passed the evaporator, unfit for market as a plain evaporated product. At least nine-tenths of this low-grade fruit is distilled and put upon the market as "Prunelle" or "Quetsche," liquors that would be called plum brandies by Americans. Not only is the inferior fruit from the prune orchards manufactured into liquors, but also that from apple, pear, plum, grape, and small fruit plantations. In some localities, chiefly the large centers like Paris, Hanover, Berlin, and Hamburg, much second-class fruit is used for making jams, jellies, marmalades, and fruit butters. Of the plum jams or marmalades the preference in France and England is for that made from the Reine Claudes, while in Austria and Germany large quantities of plum butter and marmalade made from the "quetsche" (German prune) are consumed; but as an article of commerce this latter product is of a much cheaper grade than that made of the Reine Claudes; also, while it goes into the market in tubs, casks, kegs, and stone jars, the former is put up in glass jars, fancy cups, wide-mouthed bottles, and various other dainty packages. Of the jellies, jams, marmalades, and fruit butters put upon the European markets but few are made of plums alone. Plum juice and flesh are usually mixed with apple and currant and occasionally other fruits, and the resulting product goes upon the market as "choice" products under various names. The market demand for pure plum products of this character is quite limited, notwithstanding large fruit conserving factories have been endeavoring to place such goods upon the market. At present, outside of the Reine Claudes and Mirabelles of France, England, and Germany, a small part of the "quetsche" crop of Austria, and the Bosnian product of plum butter, inferior plums are used for distillation. Quetsche, especially when of considerable age, is ranked among the finest of brandies. The best is said to be made of half "quetsche" prunes and half Mirabelles. The present price for old Quetsche is 15 per cent above other brandies of corresponding age.

In the large cities and at points where fruit packing and conserving plants are established there are distilling plants of considerable size which purchase from small dealers and growers such fruits as are unfit for general market purposes. In the rural sections and where orchards are small and scattered the distillation of waste fruits is effected by portable outfits, operated in very much the same manner as the American traveling steam wood-sawing machine. The method of conducting the work of these outfits is the same as practised by threshers, wood sawyers, and like concerns in America. A fixed charge is made by the hour or day, and all expense of running the alembic, as it is called, is borne by the distiller; the orchardist or vineyardist simply placing the properly fermented fruit in an accessible place. The charges for distillation vary with the seasons and kinds of fruits.

PACKING AND PACKAGES.

The one most neglected phase of the prune industry is that of packing and packages. In the marketing of no other fruit or food product, save possibly the coarser vegetables, is so little attention paid to attractive packing and packages. Not less than four-fifths of the product is put upon the market in large, rough boxes or bags, and especially is this the case with the smaller sizes of the European prunes and those from the Pacific Northwest. A few of the larger packing establishments of France, Germany, and California use a moderate amount of taste and a fair quality of material in their packages, while one or two French and German firms put upon the market a limited amount of very fancy packages of choice fruit. On the markets of the eastern United States and Europe prunes are usually handled like peanuts and potatoes. Instead of being handled as a prepared fruit food, they are treated as a raw article; exposed to the flying dust and dirt of the market place; shoveled and carted about just as one might handle coal, in old boxes, barrels, sacks, or trays. The result is that as the housewife passes from place to place making her purchases for the table the thought of dried prunes for sauce gives her a feeling of mild disgust, and justly so. If the average curer of prunes on the Pacific Coast could see the article as it is commonly marketed in the large cities he would feel distrustful of his own senses. Not all of the evaporated fruit is thus handled, but a large amount reaches the consumer in this way. Not alone the smaller grades, though certainly a larger per cent of these are thus sold than of the fancy grades, but some of the fruit of 40 to 45 grade is sold with so much dirt upon it that the work of preparing it for the table must be as great as for potatoes. This condition can only be overcome by adopting a style of package that will not permit handlers and dealers to foul the fruit.

There appears to be no reason why this product under ordinary conditions, provided it is protected from attack by insects, will not keep for two or three years without serious deterioration. Certainly there is no reason why it should not be placed on the market in such manner as to make it as attractive as the canned product, which is the chief competing article.* While it is possible that much of the evaporated product is of too low a grade and quality to warrant even a small additional expense for fancy packing, yet for all the higher grades and best qualities it would appear that this is a field worthy of thorough investigation by the progressive packer and shipper. In the world's markets to-day attractive packages count for at least as much as quality with the majority of buyers, and since dried prunes are looked upon by many as a coarse food it is the more important that careful attention be given to their market appearance. The glass jars, bottles, and cans in which some of the Bordeaux packers put up a portion of their fancy-quality prunes are too expensive for the general market, and yet, thus far, these are the only packages in which the fruit keeps for an indefinite period without decreasing in value through being worm-eaten and sugared. The great need at present is a cheap, light, fly and air-proof package.

METHODS OF MARKETING.

There are several features of this phase of the European prune industry that are worthy of attention by our growers. One of the first matters to attract attention is the method of making sales at the country market place. This is where the crop changes hands from the small grower and evaporator to the dealer, packer, or shipper. Every considerable village of Europe has its market place. In the larger villages and cities the "market" is of daily occurrence; in the smaller villages, once a week. With the different villages within a more or less well-defined region, the market days occur on different days of the week, thus enabling buyers to visit different sections from day to day. One of the chief prune markets of France is Sainte Livrade, in the valley of the Lot. During the curing season there is held at this place every Thursday a dried-prune market—i. e., the prune is the chief feature of the "market." Early in the morning one may see the people with all sorts of conveyances—wheelbarrows, hand-carts, donkey carts, ox carts, and carts drawn by men and women—traveling toward the market place with their prunes and other produce, and not infrequently may be seen both men and women carrying their marketable produce in hand baskets or sacks thrown over their backs. At a set time, usually about 8:30 A. M. for the prune market, the sound of a bell or horn announces that the market has opened. The buyer, with a little scale pan in hand, begins his work of testing. All about the market place, in boxes, bags, baskets, tubs, barrels, and other receptacles, are the various lots of dried fruit. As the buyers pass from lot to lot the attending saleswoman—for usually a woman attends to this part of the business—sews, knits, eats, or converses with her neighbors. After the buyers have made the rounds and sampled the offerings, as to cured condition and size, they are ready to make offers on the various lots that they have decided are worth their attention. Each buyer waits upon the several persons offering the lots that he desires, makes his bids in a confidential tone and, if acceptable, the bargain is closed: otherwise he passes on and other buyers take his place, and so the round is made until all goods are sold. Occasionally, however, some lots are kept until the next market, the price offered not being acceptable to the seller.

After sales are made the fruit is delivered by the seller to some warehouse, packing house, or depot, where it is weighed and paid for. On being received at the packing-house the fruit of each grade, as determined by its cured condition, is put into large receiving bins. Such fruit as is insufficiently dried (and frequently the proportion of this grade of fruit on the market is quite large) is spread on trays, placed on a large truck, and re-evaporated. The fruit that is properly cured is graded by means of a grader made upon the same general plan as the Cunningham grader used on the Pacific Coast. Each grade is placed in a separate bin, and after a period of sweating put through a processing bath, the composition and method of use of which the packer endeavors to keep secret. The fruit is then boxed, sacked, bottled, or canned, according to quality, appearance, and size, as the market may demand. This feature of the work is not unlike the California method of processing and packing, which is quite unknown in the Pacific Northwest, though a beginning along this line has been made by one or two firms. The culls from the grading are distilled, sometimes alone, sometimes together with fresh fruit that is considered unfit for the drier.

In many localities, and especially in northern Germany, large plants for evaporating, canning, preserving, distilling, and packing are established, and to these the growers sell their fresh fruit. Some of these establishments have men and teams traveling over the country gathering up the fresh fruit. Sometimes the crop is bought on the trees, but more often after it is picked.

As to the question of large factories or individual small evaporators, the more intelligent European dealers and producers are advocates of the plan of having large conserving plants. They realize that the large plants can be more economically handled, can prepare a more uniform grade and a greater variety of product, and are much better able to cope with the variable market conditions; a sufficient number of reasons, evidently, for their view of the question. The history of the growth of these fruit-food factories (for such they really are) in the Old World is one of much interest to the people of the Pacific Northwest, and it appears that it is only a question of time until our growers and dealers must adopt a system similar to that existing in France and Germany. The chief objection to the product of the Pacific Northwest to-day is that it is not uniform in size, quality, and pack, and that there is no certainty that an order placed and filled satisfactorily one year can be duplicated the next on a large scale. If, for example, the whole prune crop of the Willamette Valley could pass through one finishing and packing-house, there is no question, in view of French and German experience, that a fairly uniform grade and quality of product could be put upon the market from year to year, and that a stable market rating could be secured for the prune crop of this section, resulting most beneficially to the industry.

EVAPORATION.

As intimated in a previous paragraph, a large part of the prune crop of Germany and Austria is evaporated in the large commercial plants, while of the crop of France over two-thirds is evaporated in the small, individual driers ("fours" or "etuves" as they are called there). Of the former of these methods little need be said, as in a general way the plants are constructed after the Zimmerman and Alden types of American machines and are less efficient, viewed from the standpoint of an American, than the improved evaporators now in use in the Pacific Northwest. The only feature in which these European plants excel the commercial plants is that of making provision to use an inferior fruit in the preparation of various secondary products. If the fruit which comes into the plant will not make a good evaporated fruit, then it is used to make some other form of fruit product. In this latter respect our commercial evaporating plants have a great opportunity for improvement.

Of the system of evaporation in France more may be said, for the reason that the fruit prepared by this method brings the highest price on the European markets, and for the further reason that a brief discussion of this method will materially aid our growers in understanding what their present position is in this phase of the work of the world's prune industry.

As before stated the prune of France is the Agen, commonly known on the Pacific Coast as *Petite*, or *French*. For the first part of the ripening period it is allowed to fall to the ground, and if the weather is fair it is gathered every two or three days. Should the weather be foul it is gathered every day.

As shown by the prices paid at the first markets, as well as by the general appearance of the fruit itself, the first gatherings are of an inferior quality. As the season advances the trees are lightly shaken. The fruit is gathered in common hand baskets, usually by women and children, carried or carted to the building where the drier ("four" or "etuve") is located, and there, without dipping, washing, or grading in any way, is spread upon the drying trays, or "claies" as they are called. These trays are a most unique and interesting part of the apparatus. They are made of various shapes, sizes, and material. Some are square, some rectangular, and many racquet-shaped, others round, others oblong. Some are made of willow throughout, some of willow sides, while the bottom is a latticework of split broom-corn stalks or reed grass; some have a wooden framework and galvanized wire bottom, and others are made of woven rush grass. In sizes they vary from small round ones, 18 inches in diameter, to rectangular ones 2½ feet by 4 feet or as long as 6 by 2½ feet wide. In one good-sized "etuve"* (a drier that will handle 12 to 20 bushels per day) may be seen half a doven styles of trays varying as to size, shape, and the material of which they are made. The fruit having been placed upon the trays at the opening of the season, is put into the oven or drying chamber, which has been previously heated to a temperature of 70 deg. C. (158 deg. F.). The fire or heat is withdrawn at the time the fruit is put in, the chamber is closed tightly, and the fruit left for three days. During this time the fire is rekindled each morning, and when the temperature of the chamber has reached 70 deg. C. the fire is withdrawn as before. At the end of the third day the fruit is removed, the chamber closed, the fire rekindled or heat renewed, and the temperature brought up to the standard, 70 deg. C. While the fruit is out it is assorted roughly and the large prunes are dipped into red wine. All are then replaced in the oven, the heat or fire withdrawn, and at the end of twenty-four hours the fruit is again taken from the oven. This time it is assorted, all cured fruit being removed and put into baskets, the sizing being done by eye during the operation. The uncured fruit is returned to the chamber and such trays as may be empty are filled with fresh fruit. The chamber is then closed, and the process repeated from day to day until the crop is cured.

LOW TEMPERATURE RESEARCH.

An interesting contribution has recently been added to the Proceedings of the Royal Institution by Miss Agnes M. Clerke, summing up the work done by the Institution in connection with low temperatures. The funds for carrying out this investigation have largely been provided by an American, Mr. Thomas G. Hodgkins, says Engineering, who, in 1895, presented a sum of $100,000 to the Royal Institution for the promotion of research. Much, it is true, had already been accomplished, as the work of Profs. Dewar and Fleming on the resistance of materials at temperatures approaching the absolute zero was carried out in 1893, and few of the months of the following two years were unmarked by new developments of Prof. Dewar's researches. The expense was, however, great, and the work done must certainly have been restricted but for the timely present of Mr. Hodgkins, which has later on been supplemented on two occasions by the Goldsmiths' Company. Miss Clerke's summary of the work done and the results attained will be welcomed by all who have been unable to follow in detail Prof. Dewar's accounts of his work which have appeared from time to time in different publications. The culminating point was reached when in 1898 hydrogen was obtained in a static liquid condition. It proved to be an extremely light colorless liquid, only one-fourteenth as heavy as water and boiling at a temperature of —252.5 deg. C. Somewhat later, hydrogen ice was also obtained, having a freezing point of about 15 deg. C. absolute. For years hydrogen remained the one so-called permanent gas, but no sooner had its volatility been subdued than it was found that helium, a gas but newly discovered, had a still lower critical point, as it refused to liquefy even at the temperature of — 262 deg. C. By its aid, however, it is hoped that before many years a temperature within about 5 deg. of the absolute zero will at last be reached. Expensive as the liquefaction of hydrogen has been, that of helium will necessarily be much greater. By means of these low-temperature researches it has been shown that ordinary air contains about 1 part of pure hydrogen in 8,000. This is undetectable by ordinary methods of

* This year a San Francisco firm has put upon the market a package that bids fair to be the beginning of a better method of marketing this product. This is a 5-pound paper box.

* A "four" is a simple bake oven. The fire is kindled in the chamber, which is usually small, and when the heat has reached the proper degree the fire is withdrawn, and the trays of fruit are placed in the chamber and doors closed.

analysis, but by liquefying the air contained in a tube by immersing it in liquid hydrogen, spectrum analysis reveals the presence of this gas, as also of helium in the uncondensed residue. It will moreover be remembered that by fractional distillation at low temperatures Prof. Ramsay and Dr. Travers detected the presence of four new gases, besides argon, in the air which but a few years back was supposed to contain nothing but oxygen, nitrogen, a little carbonic acid, and water.

ADDRESS IN MATHEMATICS AND PHYSICS BEFORE THE BRITISH ASSOCIATION.

THE Address in Section A was by Major P. A. MacMahon, D.Sc., F.R.S., the president, who, after a review of the recent progress of mathematics, said: It has been attempted to overcome defects in training for scientific pursuits by the construction of royal roads to scientific knowledge. Engineering students have been urged to forego the study of Euclid, and, as a substitute, to practise drawing triangles and squares. It has been pointed out to them that mathematical study has but one object—viz., the practical carrying out of mathematical operations; that a collection of mathematical rules of thumb is what they should aim at; that a knowledge of the meaning of processes may be left out of account so long as a sufficient grasp of the application of the resulting rules is acquired. In particular, it has been stated that the study of the fundamental principles of the infinitesimal calculus may be profitably deferred indefinitely so long as the student is able to differentiate and integrate a few of the simplest functions that are met with in pure and applied physics. The advocates of these views are, to my mind, urging a process of

CRAMMING

for the work of life which compares unfavorably with that adopted by the so-called "crammers" for examinations. The latter I believe to be, as a rule, much maligned individuals, who succeed by good organization, hard work, and personal influence where the majority of public and private schools fail. The examinations for which their students compete encourage them to teach their pupils to think, and not to rely principally upon remembering rules. At the beginning of the nineteenth century it was possible for most workers to be well acquainted with nearly all important theories in any division of science. The number of workers was not great, and the results of their labors were for the most part concentrated in treatises, and in a few publications especially devoted to science; it was comparatively easy to follow what was being done. At the present time the state of affairs is different. The number of workers is very large; the treatises and periodical scientific journals are very numerous; the ramifications of investigation are so complicated that it is scarcely possible to acquire a competent knowledge of the progress that is being made in more than a few of the subdivisions of any division of science. Hence the so-called specialist has come into being. Evident though it be that this is necessarily

AN AGE OF SPECIALISTS,

it is curious to note that the word "specialist" is often used as a term of opprobrium, or as a symbol of narrow-mindedness. I will now advance the proposition that, with this exception, all scientific workers are specialists; it is merely a question of degree. An extreme specialist is that man who makes discoveries in only one branch, perhaps a very narrow branch, of his subject. I shall consider that in defending him I am *à fortiori* defending the man who is a specialist, but not of this extreme character. A subject of study may acquire the reputation of being narrow either because it has for some reason or other not attracted workers, and is in reality virgin soil only awaiting the arrival of a husbandman with the necessary skill, or because it is an extremely difficult subject which has resisted previous attempts to elucidate it. In the latter case, it is not likely that a scientific man will obstinately persist in trying to force an entrance through a bare blank wall. Either from weariness in striving, or from the exercise of his judgment he will turn to some other subdivision which appears to give greater promise of success. When the subject is narrow merely because it has been overlooked, the specialist has a grand opportunity for widening it, and freeing it from the reproach of being narrow. When it is narrow from its inherent difficulty he has the opportunity of exerting his full strength to pierce the barriers which close the way to discoveries. In either case the specialist, before he can determine the particular subject which is to engage his thoughts, must have a fairly wide knowledge of the whole of his subject. If he does not possess this he will most likely make a bad choice of particular subjects, or, having made a wise selection, he will lack an essential part of the mental equipment necessary for a successful investigation. Again, though the subject may be a narrow one, it by no means follows that the appropriate or possible methods of research are prescribed within narrow limits. I will instance the Theory of Numbers, which, in comparatively recent times, was a subject of small extent and of restricted application to other branches of science. The problems that presented themselves naturally, or were brought into prominence by the imaginations of great intellects, were fraught with difficulty. There seemed to be an absence, partial or complete, of the law and order that investigators had been accustomed to find in the wide realm of continuous quantity. The country to be explored was found to be full of pitfalls for the unwary. Many a lesson concerning the danger of hasty generalization had to be learnt and taken to heart. Many a false step had to be retraced. Many a road which a first reconnaissance had shown to be straight for a short distance was found, on further exploration, to suddenly change its direction and to break up into a number of paths which wandered in a fitful manner in country of increasing natural difficulty. There were few vanishing points in the perspective. Few, also, and insignificant were the peaks from which a general notion could be gathered of any considerable portion of the country. The surveying instruments were inadequate to cope with the physical characters of the land. The province of the Theory of Numbers was forbidding. Many a man returned empty-handed and baffled from the pursuit, or else was drawn into the vortex of a kind of maelstrom and had his heart crushed out of him. But early in the last century the dawn of a brighter day was breaking. A combination of great intellects—Legendre, Gauss, Eisenstein, Stephen Smith, etc.—succeeded in adapting some of the existing instruments of research in continuous quantity. These adaptations are of so difficult and ingenious a nature that they are to-day, at the commencement of a new century, the wonder and, I may add, the delight of beholders. The point I wish to urge is that these specialists in the Theory of Numbers were successful for the reason that they were not specialists at all in any narrow meaning of the word. Success was only possible because of the wide learning of the investigator; because of his accurate knowledge of the instruments that had been made effective in other branches; because he had grasped the underlying principles which caused those instruments to be effective in particular cases. Furthermore, a special study frequently creates new methods which may be subsequently found applicable in other branches. The Theory of Numbers furnishes several beautiful illustrations of this. Generally, the method is more important than the immediate result. Though the result is the offspring of the method, the method is the offspring of the search after the result. The law of Quadratic Reciprocity, a cornerstone of the edifice, stands out not only for the influence it has exerted in many branches, but also for the number of new methods to which it has given birth, which are now a portion of the stock-in-trade of a mathematician. Euler, Legendre, Gauss, Eisenstein, Jacobi, Kronecker, Poincaré, and Klein are great names that will be forever associated with it. Who can forget the work of H. J. S. Smith on homogeneous forms and on the five-square theorem, work which gave rise to processes that have proved invaluable over a wide field, and which supplied many connecting links between departments which were previously in more or less complete isolation? In this connection I will further mention two branches with which I may claim to have a special acquaintance—

THE THEORY OF INVARIANTS,

and the combinatorial analysis. The theory of invariants was evolved by the combined efforts of Boole, Cayley, Sylvester, and Salmon, and has progressed during the last sixty years with the co-operation, among others, of Aronhold, Clebsch, Gordan, Brioschi, Lie, Klein, Poincaré, Forsyth, Hilbert, Elliott, and Young. It involves a principle which is of wide significance in all the subject-matters of inorganic science, of organic science, and of mental, moral, and political philosophy. In any subject of inquiry there are certain entities, the mutual relations of which under various conditions it is desirable to ascertain. A certain combination of these entities may be found to have an unalterable value when the entities are submitted to certain processes or are made the subjects of certain operations. The theory of invariants in its widest scientific meaning determines the combinations, elucidates their properties, and expresses results when possible in terms of them. Many of the general principles of political science and economics can be expressed by means of invariantive relations connecting the factors which enter as entities into the special problems. The great principle of chemical science which asserts that when elementary or compound bodies combine with one another the total weight of the materials is unchanged, is another case in point. Again, in physics, a given mass of gas under the operation of varying pressure and temperature has the well-known invariant pressure multiplied by volume and divided by absolute temperature. Examples might be multiplied. In mathematics the entities under examination may be arithmetical, algebraical, or geometrical; the processes to which they are subjected may be any of those which are met with in mathematical work. It is the *principle* which is so valuable. It is the *idea* of invariance that pervades to-day all branches of mathematics. It is found that in investigations the invariantive fractions are those which persist in presenting themselves, even when the processes involved are not such as to insure the invariance of those functions. Guided by analogy, may we not anticipate similar phenomena in other fields of work?

THE COMBINATORIAL ANALYSIS

may be described as occupying an extensive region between the algebras of discontinuous quantity. It is to a certain extent a science of enumeration, of measurement by means of integers as opposed to measurement of quantities which vary by infinitesimal increments. It is also concerned with arrangements in which difference of quality and relative positions in one, two, or three dimensions are factors. Its chief problem is the formation of connecting roads between the sciences of discontinuous and continuous quantity; to enable, on the one hand, the treatment of quantities which vary *per saltum*, either in magnitude or position, by the methods of the science of continuously varying quantity and position, and on the other hand to reduce problems of continuity to the resources available for the management of discontinuity. These two roads of research should be regarded as penetrating deeply into the domains which they connect. In the early days of the revival of mathematical learning in Europe the subject of "combinations" cannot be said to have rested upon a scientific basis. It was brought forward in the shape of a number of isolated questions of arrangement, which were solved by mere counting. Their solutions did not further the general progress, but were merely valuable in connection with the special problems. Life and form, however, were infused when it was recognized by De Moivre, Bernouilli, and others that it was possible to create a science of probability on the basis of enumeration and arrangement. Jacob Bernouilli, in his "Ars Conjectandi," 1713, established the fundamental principles of the calculus of probabilities. A systematic advance in certain questions which depend upon the partitions of numbers was only possible when Euler showed that the identity $x^a x^b = x^{a+b}$ reduced arithmetical addition to algebraical multiplication and vice versa. Starting with this notion, Euler developed a theory of generatng functions on the expansion of which depended the formal solutions of many problems. The subsequent work of Cayley and Sylvester rested on the same idea, and gave rise to many improvements. The combinations under enumeration had all to do with what may be termed arrangements on a line subject to certain laws. The results were important algebraically as throwing light on the theory of algebraic series, but another large class of problems remained untouched, and was considered as being both outside the scope and beyond the power of the method. I propose to give some account of these problems, and to give a short history of the way in which a method of solution had been reached. Conceive a rectangular lattice or generalized chess-board (*cf.* "Gitter," Klein), whose compartments are situations for given numbers or quantities, so that there is a rectangular array of certain entities. The general problem is the enumeration of the arrays when both the rows and the columns of the lattice satisfy certain conditions. With the simplest of such problems certain progress has undoubtedly been made. The article on

MAGIC SQUARES

in the Encyclopædia Britannica and others on the same subject in various scientific publications are examples of such progress, but the position of isolation was not sensibly ameliorated. Again, the well-known *probleme des rencontres* is an instance in point. Here the problem is to place a number of different entities in an assigned order in a line and beneath them the same entities in a different order subject to the condition that the entities in the same vertical line are to be different. This easy question has been solved by generating functions, finite differences, and in many other ways. In fact, when the number of rows is restricted to two the difficulties inherent in the problem when more than two rows are in question do not present themselves. The problem of the Latin Square is concerned with a square of order n and n different quantities which have to be placed one in each of the n^2 compartments in such wise that each row and each column contains each of the quantities. The enumeration of such arrangements was studied by mathematicians from Euler to Cayley without any real progress being made. In reply to the remark "Cui bono?" I should say that such arrangements have presented themselves for investigation in other branches of mathematics. Symbolical algebras, and in particular the theory of discontinuous groups of operations, have their laws defined by what Cayley has termed a multiplication table. Such multiplication tables are necessarily Latin Squares, though it is not conversely true that every Latin Square corresponds to a multiplication table. One of the most important questions awaiting solution in connection with the theory of finite discontinuous groups is the enumeration of the types of groups of given order or of Latin Squares which satisfy additional conditions. It thus comes about that the subject of Latin Squares is important in mathematics, and some new method of dealing with them imperative. A fundamental idea was that it might be possible to find some mathematical operation of which a particular Latin Square might be the diagrammatical representative. If, then, a one-to-one correspondence could be established between such mathematical operations and the Latin Squares, the enumeration might conceivably follow. Bearing this notion in mind, consider the differentiation of x^n with regard to x. Noticing that the result is $n x^{n-1}$ (n an integer), let us inquire whether we can break up the operation of differentiation into n elementary portions, each of which will contribute a unit to the resulting coefficient n. If we write down x^n as the product of n letters—viz., $x x x x \ldots$, it is obvious that if we substitute unity in place of a single x in all possible ways, and add together the results, we shall obtain $n x^{n-1}$. We have, therefore, n different elementary operations, each of which consists in substituting unity for x. We may denote these diagrammatically by—

$$\begin{array}{|c|c|c|c|l}\hline 1 & & & & \cdots \\ \hline\end{array} \qquad \begin{array}{|c|c|c|c|l}\hline & 1 & & & \cdots \\ \hline\end{array}$$

$$\begin{array}{|c|c|c|c|l}\hline & & 1 & & \cdots\cdots \\ \hline\end{array}$$

and from this point of view $\dfrac{d}{dx}$ is a combinatorial symbol, and denotes by the coefficient n the number of ways of selecting one out of the n different things. The second new method in analysis that I desire to bring before the section has its origin in

THE THEORY OF PARTITION.

Diophantus was accustomed to consider algebraical questions in which the symbols of quantity were subject to certain conditions, such, for instance, that they must denote positive numbers or integer numbers. A usual condition with him was that the quantities must denote positive integers. All such problems and particularly those last specified are qualified by the adjective Diophantine. The partition of numbers is then on all fours with the Diophantine equation—

$$\alpha + \beta + \gamma \quad . \quad + \iota = n,$$

a further condition being that one solution only is given by a group of numbers $\alpha, \beta, \gamma \ldots$ satisfying the equation; that, in fact, permutations among the quantities $\alpha, \beta, \gamma \ldots$ are not to be taken into account. This further condition is brought in analytically by adding the Diophantine inequalities—

$$\alpha \geqq \beta \geqq \gamma \geqq \ldots \geqq \nu \geqq 0$$

ν in number. The importation of this idea leads to valuable results in the theory of the subject which suggested it. A generating function can be formed which involves in its construction the Diophantine equation and inequalities, and leads after treatment to a representative as well as enumerative solution of the problem. It enables, further, the establishment of a group of fundamental parts of the partitions

from which all possible partitions of numbers can be formed by addition with repetition. In the case of simple unrestricted partition it gives directly the composition by rows of units which is in fact carried out by the Ferrers-Sylvester graphical representation and has led in the hands of the latter to important results in connection with algebraical series which present themselves in elliptic functions and in other departments of mathematics. Other branches of analysis and geometry supply instances of the value of extreme specialization.

A NEW METHOD FOR JUDGING THE AUTHORSHIP OF HANDWRITING.

By DR. PERSIFOR FRAZER.

WHILE studying the peculiarities of pen marks in 1898 I was struck by the fact that under high magnification the unevennesses on each margin of a pen mark preserved a similar general character in pen strokes of a given writer, and that the number of the irregularities usually differed on the two sides in a given space. The results of this method of investigation, which I had reached in February, 1901, were embodied in Chapter X. of "Bibliotics," which was issued by the J. B. Lippincott Company at that time. Extensive experimentation since has confirmed the accuracy of these observations, and has led to additional interesting results to which it is my purpose to call attention in this article.

The similarity of the magnified pen strokes of a writer is like that of the fractured edges of two specimens of the same mineral or rock. It does not consist in a repetition of the same indentations at corresponding places of the two lines, but in a general effect on the eye which enables the experienced naturalist in the analogous case just mentioned to distinguish the fractures of slate, granite, sandstone and limestone, etc., from each other.

The phenomenon when more closely studied in handwriting resolves itself into two. The first is a succession of serrations of different sizes on each edge of the ink line examined, and usually preponderating on one of them; and the second is an alternate widening and narrowing of the line visible in the more or less perfect opposition of two of the larger serrations at successive intervals. That these phenomena are not due to differences in the pens, ink, and paper and to the invisible tremors which affect all objects on the vibrating surface of the earth, is apparent from two facts: first, because pen lines drawn by a machine lack altogether the larger serrations and the rhythmic widening and narrowing of the line; and, second because the different lines of a given writer maintain characteristics peculiar to him despite the differences in outward appearance which result from changing the quality of the pens, ink, and paper. These are, in my judgment, a sufficient answer to the supposition that the appearances are due to motions and materials independent of the writers, whatever be their final physiological explanation.

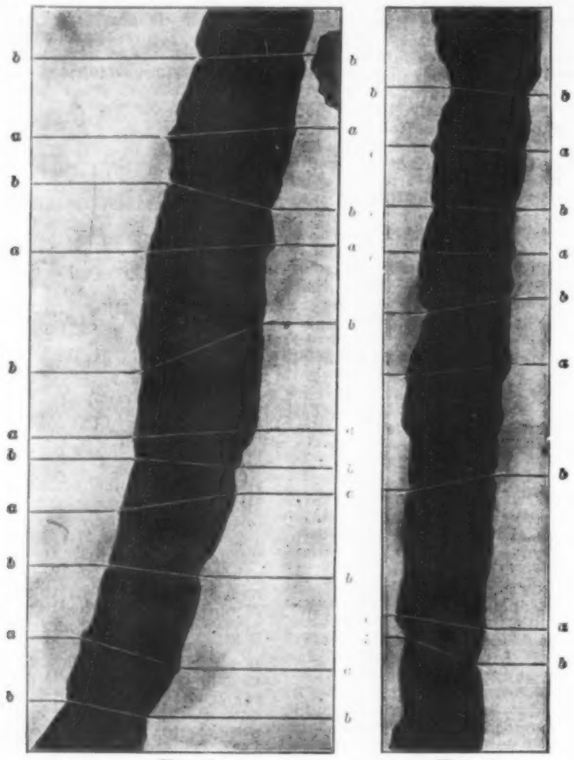


FIG. 1. FIG. 2.

The points *a* show the widest and *b* the narrowest parts of the ink lines. It is to be noted that the maxima and minima of the two margins are not always opposite to each other, but show a tendency to oscillate about a horizontal line, so that the *a*'s and *b*'s of one margin will be observed alternately above and below such line in following the ink mark downward, while those of the other margin will be found in opposite phase. This is made clearer by the white lines uniting the *a*'s and *b*'s of the opposite margins.

This can be accounted for by the simultaneous operation of lateral and vertical movements, which are not coincident in period. **Magnified 30 diameters.**

Concisely stated, the case stands thus: In any ink lines of sufficient length made by the human hand there may be observed deviations right and left from the course the writer intended to follow, inversely proportionate in number and extent to the control of the writer over the pen. These irregularities are visible to the naked eye and, in connection with the greater or less correctness of the designs or models of the letters on which they are observed, give to the observer his impression of the expertness, feebleness, illiteracy, etc., of the writer. Visible to the naked eye they are also greatly affected by states of mind and body, the influence of drugs, etc.

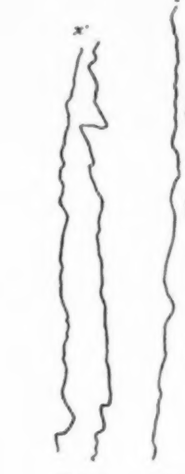


FIG. 3. FIG. 4.

Camera lucida tracing of margins of ink lines in the two words reproduced on next page.

But if a high magnifying power be applied to ink lines made by human hands there will be found much finer deviations entirely invisible to the naked eye. It is not known to what extent the states of mind aforementioned influence these much subtler vibrations of the writing hand, but it is certain, from experiments made, that it is far less than in the case of the visible irregularities. That is to say, that the crooked, zigzag characters of a drunken writer when highly magnified do not reveal an increase in number or size of the fine serrations proportionate to the change of the visible parts, when compared with the normal writing of the same hand.

If handwriting be magnified to about thirty diameters (900 times the actual size) the sinuosities of the

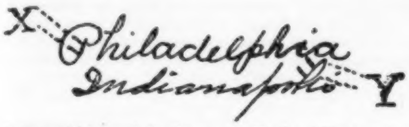
Photomicrograph of an ink line made by Professor Lightner Witmer. Magnified 120 diameters.

FIG. 5.

Photomicrograph of pencil line made by Professor Lightner Witmer. Magnified 120 diameters.

FIG. 6.

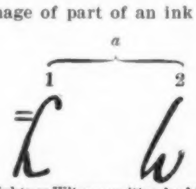
longer strokes (intended to be straight) the gross alterations in the width of the line due to measurable variations in vertical pressure, and the largest of the serrations due to unconscious lateral movements come into view (Figs. 1 and 2).



Words from which the photomicrographs, Fig. 1 and Fig. 2, and camera-lucida tracing X′ and Y′ were taken. The dotted lines indicate the portions of the letters represented.

Figs. 1 and 2 are magnified fragments of two downstrokes; the *P* in "Philadelphia" and the *I* in "Indianapolis," written by two different persons, and each magnified thirty diameters. Lines have been drawn across the figures to indicate the maxima (*a*) and minima (*b*) of width of the two lines. If the position of the pen with reference to the paper remained the same when these maxima and minima were produced, the lines joining them would be parallel. But if the pen-holder rotates between the fingers, or the direction of the pen, and with it the fingers, is altered as shown by the slightly sinuous line in Fig. 1, the lines joining successive pairs of maxima and minima will be oblique to each other. This is strikingly shown in the figures, and it will be observed that the straighter line (Fig. 2) shows, on the whole, greater parallelism of these transverse maxima and minima lines. Figs. 3 and 4 are camera lucida tracings of the margins of the *P* and *I* in the original writing at much greater magnification, viz., ±60 diameters. In these figures, as it was only intended to show the appearance of the margins, the latter have been crowded together to save space. They introduce us, however, to the next order of irregularities observable at high magnification. Only the very largest of the indentations are visible in Figs. 1 and 2. Those of intermediate size and clearly of human origin form a characteristic peculiar to the writer, besides indicating which margin has the greatest number of serrations. The finest serrations on 3 and 4 are of doubtful origin, and such are ordinarily neglected in these studies.

Fig. 5 is an image of part of an ink line and Fig. 6



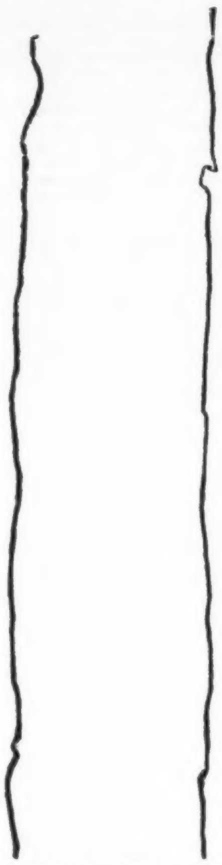
Initials of Professor Lightner Witmer written by himself. The double lines indicate the portion of the letter represented.

of part of a pencil line, both written by Prof. Lightner Witmer of the University of Pennsylvania and magnified 120 diameters.

Fig. 7 is part of an ink-line made by a ruling machine and magnified 180 diameters, and Fig. 8 is a camera lucida drawing of the margins of this same line magnified 120 diameters. The absence of all the characteristics of writing by a human hand is noticeable in these illustrations.

For the purpose of testing whether the preponderance of serrations and the frequency of maxima of width were fairly constant in a given writer, I have selected a concrete subject, remote from sensationalism, viz., the signature of Gen Washington on a letter to my great-grandfather. The study of the writing on this document is more difficult than usual because the ink has been much decomposed during the intervening 124 years.

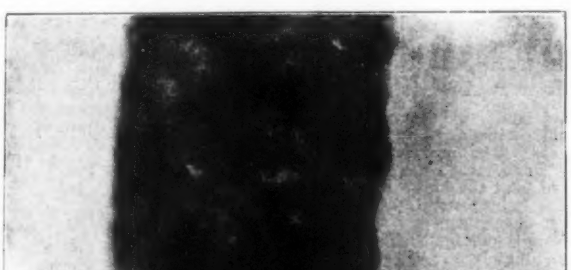
The discussion of the origin of these serrations and



Camera lucida tracing of a machine-drawn line. Pen-nibs inclined 45° to plane of paper and pressing equally on it. Direction of motion of pen perpendicular to line of intersection of planes of nibs and paper and downward. Magnification, 120 diameters.

FIG. 8.

nodes is not a necessary part of a memoir on the utilization of the resulting forms for the purpose of confirming or casting doubt on the supposed authorship of handwriting. It is enough to know that they are of human origin, and sufficiently constant in general form to justify the conclusion that they are the results of individual characteristics. The former proposition has been abundantly demonstrated by experiment and is corroborated by a number of physiologists of high authority.

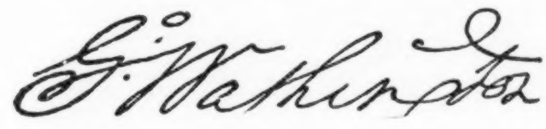


Photomicrograph of a machine-drawn ink line made with an ordinary steel pen, the nibs pressing equally on the paper and being drawn downward. The scarcity of serrations and the absence of curvature on the margins are noticeable. Magnified 180 diameters.

FIG. 7.

On examining fourteen tremograms of the signature, of which only three are reproduced here, nine clearly show a majority of the serrations on the right hand margin of the ink lines. Four of the remaining five apparently have the greatest number of serrations on the left side, but in every case the observation is rendered somewhat doubtful on account of the decomposed condition of the ink, which introduces fantastic irregularities where there was once a plain line. The fourteenth is so much affected by this action that it is impossible to use it. It may, therefore, with tolerable safety be affirmed that Gen. Washington wrote the greater part of the signature under examination with the right nib of the pen pressing more heavily upon the paper than the left nib; and, as he was the most methodical and systematic of men, it is probable that this was his usual habit of writing.

The second examination of the writing is for the purpose of ascertaining the average distance apart of the maxima and minima of the width of the ink lines



This signature of Washington may be described as characterized by a predominance of serrations on the right margin of the down-stroke ink lines, and a frequency of recurrence of the maxima and minima in width of line equal to 30.5 of the arbitrary units selected, or about every 0.16 mm. (0.0063 inch) of the actual line.

FIG. 9.

corresponding to successive vertical movements of the point of the pen.

It is evident that the longer the series of consecutive parts observed, the more nearly can an approximation to the true ratio be had. It is inevitable that the record of such rapid movements with such imperfect instruments as the ordinary writing utensils should be in the highest degree irregular, and only when a comparatively large number of observations have been made can an approximation to the normal rate be attained.

In Fig. 10, 1, 2, and 3 are successive parts of the downward stroke tail of the *G* below the hair-line finish of the first initial.

Some control of these irregularities has been obtained by measuring the distances both between maxima and between minima (which must approximately agree since they must necessarily alternate with each other). In the camera lucida tracings of the outlines of ink lines the figures are magnified ±60 diameters.

In every case the distance between the upper and lower maxima and minima lines on each side have been measured in 0.63 mm. or fortieths of an inch. The number of units in each case has been divided by the number of maxima or minima lying within this distance, and the quotient gives the mean distance apart of the maxima and minima in these units.

In spite of the apparent irregularity of the tracings, the agreement of the averages is quite close and seems to preclude coincidence. The conclusion to which they lead is that in Washington's writing the recurrence of these vertical pressures was less frequent than in the average chirography, and if, as is most probable, they are due to neuro-muscular action it furnishes another proof of the well-balanced nervous organization of the Father of his Country.

In consequence of the oscillation of the plane of the pen-nibs and lack of coincidence between the rates of

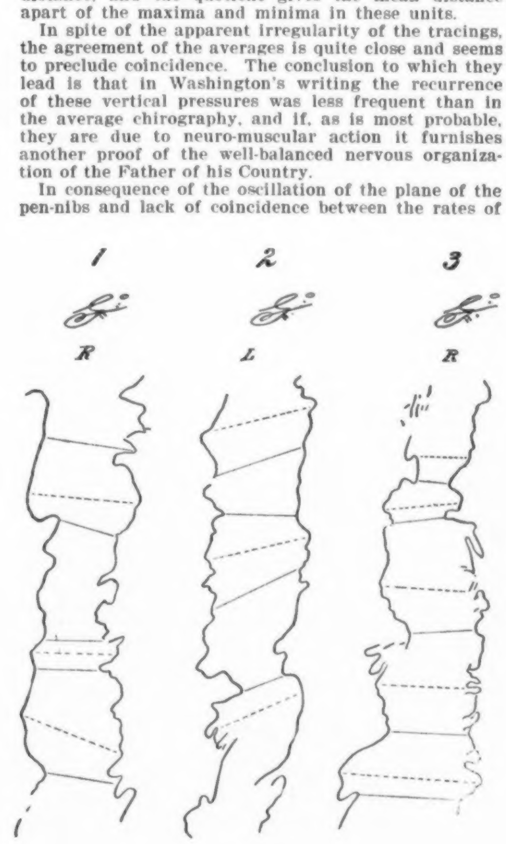


FIG 10.

lateral and of vertical movement, the lines joining maxima and minima of width on the two margins are rarely approximately parallel; and, as the measurements are made in the general direction in which the ink line was drawn, it only occasionally happens that the distances between the extremes of the right and left intersections of these transverse lines with the margins of the ink line agree, in the very small number of such maxima which can be included in a tracing under the microscope at 120 diameters.

If instead of five or six such consecutive maxima fifty or sixty could be obtained, these discrepancies would be more completely eliminated; but this is manifestly impossible, not only because of the diffi-

culty of placing one field exactly next to another, but because the down-stroke lines are seldom long enough, and any other than down-strokes introduce complications with which we are not yet prepared to deal. In spite of this, however, the indications are not without distinct value, and furnish a close approximation to the truth.

From the examination it results that the average distance between the maxima and minima of width of line in Washington's writing was about 0.16 mm. or upward of six thousandths of an inch.

One of the difficulties attending this method of examination is the correct indication of those sinuses and cusps which correspond on opposite sides of the line. A pronounced indentation or protuberance will occasionally be found with none on the opposite side. Generally such a feature is disregarded. Again it will happen that opposite to a distinct maximum or minimum feature there is a wavering line containing two faint representatives of a similar feature with a faint representative of the opposite feature separating them.

In such a case the distinct maximum is connected with the minimum on the opposite sides dividing the two faint maxima.

These changes are of such great frequency, and so small compared to the point of the pen tracing them, that it is probable they are produced by rapid changes in the periphery of the minute column of ink passing from the rapidly moving pen onto the sheet, and therefore are influenced not so much by the separation and reunion of the pen nibs, as by minute changes in the vertical height of the pen from the paper, whereby the column is widened or narrowed.

In Fig. 11, 1, 2, and 3 illustrate roughly the varying width of the base of the ink column (for which the term "unduloid" has been suggested by Prof. Goodspeed) connecting the pen with the paper where these latter are separated for minute distances and fractions of time. 1 represents the pen at a maximum distance from the paper where the base of the column will be a minimum. 2 shows the pen closer to the paper and the base of the column broader. 3 illustrates the base of the column when one of the pen nibs is in contact with the paper. In this position an almost infinitesimal variation in pressure will instantly change the area of the ink column in contact with the paper. These sudden changes, in response to which the ink column shoots out and retracts, are perhaps mainly the origin of these swellings and narrowings of the line, while the tiny waves produced by the lateral tremors of the pen produce the finer serrations. The finest of all—those which are neglected in the effort to identify writing—may be largely caused

Hypothetical diagram of ink column at varying distances of the pen from the paper.

Fig. 11.

by the accidental vibrations from which no object on the earth's surface is free.

Note.—In a criticism of the chapter treating of this subject in the third edition of my "Bibliotics" Mr. William E. Hagan was mentioned as having formerly employed this method in the examination of handwriting. In answer to a letter of inquiry he referred to his testimony in the probate of the will of Gertrude B. Callaghan before Surrogate D. C. Calvin in New York city, April 12, 1879. With some difficulty I obtained access to the stenographer's record of this hearing. From Mr. Hagan's testimony it appears that Dr. R. H. Wood of Troy and he, in 1871-72, conjointly noticed the irregularities of the margins of the ink lines in writing, and in the case in question Mr. Hagan employed these, which he characterized as "three waves," to identify a writer.

It is evident that these "waves" were not the serrations figured in these illustrations, because only the largest of the latter are visible at the magnification of thirty to fifty diameters which he employed; and also because he ascribes the phenomena which he was considering, in part at least, to pulse beats, which have only about one-sixtieth of the frequency indicated by many of the serrations. The alternating width of lines was not mentioned by Dr. Wood and Mr. Hagan at all. Nevertheless, to Dr. Wood and Mr. Hagan properly belongs the credit of first applying the microscopic examination of ink lines to the identification of handwriting.

I have adopted the word "tremograph" or "tremogram" for these magnified images of ink lines, from two papers containing the results of experiments undertaken by Augustus A. Eshner, M.D., at the instigation of Dr. S. Weir Mitchell, to ascertain the normal and abnormal vertical (gross) tremors of the human hand. His records obtained on a kymographion (or wave recorder) represent the alternating pressures of the fingers, or thumb and fingers, upon an elastic disk held between them, and take no note of the lateral movements which cause the serrations, but only the coarser vertical pressures, of which the force can be measured in ounces.

RECLAMATION OF SALT MARSH LANDS.*

Tidal swamps or salt marshes are a prominent feature in nearly all States which border the Atlantic or Pacific Ocean. A few years ago much was heard about their reclamation. Their value as farming lands was clearly shown, and the fact that they were a serious menace to the health of people in the vicinity was dwelt upon. About this time several government reports were issued. Notable among these reports were "Sea Coast Marshes of the United States," by N. S. Shaler, published in the Sixth Annual Report of the U. S. Geological Survey; "Tidal Marshes of the United States," by D. M. Nesbit, published as Special Report No. 7 of the U. S. Department of Agriculture, and numerous notes and reports in the publications of the New Jersey Geological Survey. Some of these reports are out of print and all are now difficult to obtain.

Within the last ten years investigations have been pursued by scientists in Europe and this country which have conclusively proved that certain species of mosquitoes are the most common, if not the only means of conveying malarial germs and of introducing those germs into the human system. More recently mosquitoes have been found to be the cause, and so far the only proved cause, of the infection of yellow fever. Marshes and stagnant pools of water are the principal breeding places of mosquitoes, and to remove the pests such places should be drained and the lands reclaimed for agricultural purposes. In Italy the mosquito pest has been the cause of the abandonment of vast areas of land. The salt marshes do not seem to offer the condition necessary for the breeding of the few species of malaria mosquito existing in this country, but they are breeding places for vast numbers of individuals of other species which annoy individuals and stock along much of the coast line and in certain places impair the property valuation.

These recent discoveries of the cause of the infection from malaria and yellow fever have resulted in a renewed interest in the means of exterminating mosquitoes and incidentally in the drying out of marshes and swamps. The writings of Dr. L. O. Howard, Entomologist of this Department, on mosquitoes have aroused the interest of the inhabitants of mosquito and malaria-infested localities in the subject of swamp reclamation; and this Bureau is in frequent receipt of letters inquiring about the agricultural value of the marsh lands and methods for their reclamation. A great many people seem willing to undertake the drainage of these marshes and tidal meadows if it can be shown to them that there will result a pecuniary profit. Therefore, to determine the agricultural value of these soils a trip was made to Oyster Bay, L. I., where reclamation work was in progress. Samples of the soil and subsoil of the eel-grass mud were collected and subjected to laboratory examination. No elaborate study of the subject is possible at this time, so a simple statement of the conditions existing there is all that can be made.

The conditions are sufficiently typical of coast marshes all along the Atlantic coast to warrant the application to other localities of any lessons learned. The opinions of several earlier writers on the subject have been quoted, and it is to be hoped the value of marsh lands has been brought out clearly enough to direct more serious attention to their reclamation. Shaler* says:

"The great advantage of the northern marsh areas is found in the fact that they are generally near the larger centers of population of the country, where they will have a high value as market garden soils or fields for the raising of hay. When brought into their best state such areas will, measured by the price set upon other lands in the same neighborhood, have a value of not less than $200 an acre. As the total reclaimable area between New York and Portland (Maine) probably exceeds 200,000 acres, the money value of their best state will amount to at least $40,000,000. The cost of reclaiming these lands and reducing them to cultivation should not exceed the fifth of this sum."

In European countries salt marshes are regarded as the most fertile of lands. Large areas in Holland, Denmark, Germany, and Belgium have been cultivated for many years. In England the Fens to the extent of probably more than 1,000,000 acres have been diked and ditched and are now in a "state of matchless fertility."

The reclamation of tidal lands to be successful at a minimum expense should be managed by a man of experience in such matters. The question of how to build dikes, the cheapest and most efficient method of drainage to be employed, and the subsequent management of the soil to bring it into a state of fertility at the earliest possible moment, are all problems which require experience and judgment if the work is to be a success. Unfortunately in America there are no trained agricultural engineers, nor is there an institution of learning which claims to train expert agricultural engineers. The best person, then, to plan and manage the reclamation is a civil engineer who has had experience in some related work. Men of experience have a habit of charging well for their services, but the money spent in fees to the right man is well invested. Diking and ditching done by inexperienced or careless persons will require more in repairs each year than would have been necessary to insure proper supervision in the first instance.

Shaler (loc. cit., p. 377) very aptly says:

"Where efforts have been made to exclude the sea and actually till the land they have sometimes been unsuccessful, owing to the failure of those who carried on the trial to see the true condition of the work. It is very much to be regretted that these experiments are not directed by some one trained in the work as it is effected on the northern shores of Europe, who could have brought to the task the accumulated experience of centuries; if this had been done it is tolerably certain that the process of turning these American marshes to agriculture would now be well advanced."

RECLAMATION OF TIDAL MARSHES.

The first step in the reclamation of tidal marshes is the exclusion of the sea. Ordinarily the marshes are covered by sea water only at high tide—some of them at every tide and others only at the highest or spring tides. Salt water is harmful to ordinary farm crops and its presence in the soil will effectively prevent cultivation. To exclude the sea a dike or embankment must be built at least two feet higher than the highest tide. The method of building such dikes must, of course, depend upon the locality, the exposure to wave action, and the kind of dike-building material at hand. The material in most common use is the sod and soil from the marsh itself. It is cut from the swamp just inside of the position to be occupied by the dike and the excavation acts as a drainage canal. The outer slopes of the dike should have a grade of at least 1½ horizontal to 1 vertical and should be shielded from wave cutting by being well sodded with the marsh sod. On exposed shores, where the wave action may be great, special precaution should be taken to prevent washing by waves. The precaution may take the form of masonry work or stone facing in the more substantial dikes, or it may be a simple brush fence held in place by stakes driven in the ground. Various expedients of this nature, both cheap and effective, will suggest themselves to the engineer.

The ditch on the inside of the dike should be designed for drainage. This ditch is usually situated along the lowest portion of the marsh and is well placed to receive the lateral drains from the higher portions, and, being at one end of the field, it is of little obstruction in the way of cultivation. The dimensions of this ditch will be governed by the amount of material required to construct the dike, if the dike material is all taken from the ditch. A mistake is often made in digging the ditch too wide. Consideration must also be given to the amount of water from the entire watershed emptying into the drains to be removed in a given time. It is very seldom necessary to remove more than one-half of an inch in depth of water in any twenty-four hours, and if the ditches are planned to carry this much water the drainage is good. Under certain conditions the open ditches should have a capacity of as much as one inch in depth over the entire watershed tributary to the ditch. The outlet of the main drains should be through the dike by means of an automatic sluice or tidal gate. Ample storage for the drainage water which may accumulate during high tide should be allowed and the sluice gates should be of at least twice the capacity of the main ditch, so that the entire drainage during high tide may be removed during the interval of low tide.

On exposed coasts, where the maintenance of an outlet would be difficult or when the drainage is desired at a level lower than the lowest tide, some other means of getting the water over the dike must be planned. Windmills have been favored in European countries and have been used in a small way in America. Various forms of pumps of cheap construction and of great efficiency are now in the market, and when driven by steam or gasoline engines are probably the cheapest form of water-lifting machinery and are not dependent upon the vagaries of the wind. Such a lifting plant need not be run all of the time, if storage of the drainage water can be allowed. The conditions are exceptional where the pumping is necessary during the entire growing season.

UNDERDRAINAGE.

Tile drains are the most effective means of removing water from land and in the course of time will prove the cheapest. Farmers' Bulletin No. 40 of this department treats of farm drainage, and more detailed information can be obtained from various publications on the subject.

In the ordinary condition in which tidal marshes are found, it is unwise to place tile until the land has had opportunity to drain and settle; otherwise in the settling the tile will be displaced and rendered of little use. For this reason the ditches for the tile drains should be dug and allowed to work as open drains until the excess of water from the soil and the settling which accompanies the drainage is over. In cases of very peaty swamps this sinking is great and continues for a long time. More permanent open drains are then essential, but they should be maintained as open drains no longer than necessary.

The distances between the drains will vary with the soil. In light porous soils a distance of 100 feet is allowable, while in stiff and tight clays drains 30 feet apart are sometimes necessary. The minimum depth should be 3 feet for general farming or trucking, but for grass land the drains are as effective if placed not deeper than from 18 inches to 2 feet.

The grade on which the tile is to be laid is largely to be governed by the height of the marsh above low water. The tendency is to use very few of the 1½-inch or 2-inch tiles, but to make 3-inch tiles the smallest used. The smaller tiles are found difficult to lay and keep in operation, and the 3-inch tiles are not more expensive and are much more effective.

WASHING OUT THE SALT.

In salt marshes the tile drains are for two purposes: First, to remove the salt which has been left by the water, and second, to remove promptly any excess of water which may be present or fall on the marsh. In order that the salt may be removed it must be dissolved in water and that water drained away. The usual way of reclaiming the meadows is to allow the rain to wash out the salt. This is a slow practice, requiring usually two or three years. The sweetening can be accelerated by irrigation with fresh water, if such is at hand. When the land is to be reclaimed by irrigation small amounts of water should be applied at frequent intervals rather than a single heavy flooding as is the practice. If small applications of water, not more than enough to cover the ground to a depth of from one to two inches, with sufficient time between the applications to allow the drains to carry away all the excess of water, be applied the land can be sweetened in one season or less. If the natural sweetening process is followed, the native salt grass should be allowed to grow at first and tame grasses will gradually take the place of the salt grasses as the salt is removed by the drainage.

CULTIVATION OF MARSH.

After the land has been diked and ditched, the best method of cultivation must be settled upon. If the soil is a tidal mud or silt, without a covering of any kind, the cultivation can be commenced at once or at least as soon as part of the salt is leached out. A great variety of crops is adapted to such soils. Cleaning the land of all weed seed and giving it an opportunity to be thoroughly aerated and weathered, by planting some cultivated crop, such as corn, is recommended for one or two years. After that time the best crop to select is the one best suited to the locality; whether it be truck, hay, cabbage, celery or small fruits will depend on the market and tastes of the cultivator.

* Circular Bureau of Soils, United States Department of Agriculture.

* Sea Coast Swamps of the Eastern United States, U. S. Geological Survey, 6th Ann. Rep., p. 380, 18.

If, however, the tidal silt or mud or eelgrass clay, as it is generally known, is not at the surface, but is covered by a sod formed of the partly decayed stems and roots of the salt grasses, a very different method of treatment is necessary in order to get the soil in condition to cultivate. If this sod is thin and well rotted, disking, deep plowing, and thorough cultivation will generally break it up and enable a good seed bed to be prepared; but when it is a foot deep, and is in turn underlaid by half decomposed sod for a depth of a foot or two, the breaking up and incorporation with the underlying soil in a short time by cultivation are impossible. The best method of subduing such soil is to burn off the sod. When it is fairly dry to a depth of twelve inches fires should be started at a number of places and the sod allowed to slowly smolder. The burning should be carried on until the eel-grass clay is close to the surface. Then by plowing the soil can be worked into condition. Burning was formerly a practice in common use in European agriculture, and is yet continued in the marsh soils of northern Germany, Denmark, and Holland. The smoke of this burning is said at times to be noticeable as far as Italy. The sod is there burned to a depth of 10 or 12 inches only, and is then cultivated for from five to ten years and burned again.

Such a practice will in time burn the entire peat of the swamps and leave the underlying soil bare. The practice is very prodigal of organic matter and is not to be recommended in America, especially since there are crops which grow to best advantage in peat. In celery areas, where such peaty soils are handled, burning is not the usual practice; in fact, the organic matter is the desirable part of the soil for the production of celery. In such areas some cultivated crop is planted for one or two years to give the peat an opportunity to decay. Rather shallow open drains are dug and the soil slowly dried out. When the first plowing is done the peat is often wet and boggy, so that it is impossible to drive a horse across the bog. Ingenious farmers in Southern California attach a board to the feet of the horse the first time the bog is plowed. Though most horses are not used to working with "snow shoes," as they are called, they soon learn the proper swing to give the feet, and the work of plowing goes on nicely.

The judgment of the farmer must be the guide as to the best method to proceed to bring the land into good tilth. As a rule burning is a waste of organic matter which in the later years of cultivation will be needed. However, it is frequently better policy to burn off troublesome sod and trust to later stable or green manuring to keep the supply of organic matter up to the standard.

As a rule salt marshes are well supplied with lime in the form of shells. Such soils in decaying will not need to be limed. Sometimes, however, the shells are not present and the soil is either acid in its natural condition or soon becomes so through the decomposition of the organic matter. Lime is then necessary to correct the acidity. Either shell marl or shell lime is usually obtainable at low cost near the coast.

Sulphide of iron is sometimes present in marsh lands and by its decomposition it gives off hydrogen sulphide gas and soluble iron compounds or sulphuric acid, all of which are harmful to plants. Thorough aeration will remove the hydrogen sulphide, but the poisonous iron compounds are more difficult to get rid of. Weathering and aeration with the application of lime, both as carbonate and sulphate, are the best methods known for the correction of the toxic effect of iron in the soil. The iron is most often found only in spots and small areas which slowly yield to cultivation. Very seldom does it cover large areas.

CROPS DURING RECLAMATION.

As has been stated before, the easiest method of reclaiming the salt marsh is to make the best use possible of the native salt grasses and to allow the tame grasses to come in as the salt is removed by drainage. This process can be accelerated by seeding with small quantities of tame grass—timothy and red-top clover are both good—on the parts of the marsh which contain the least salt. Three years will probably be required to get a stand of tame grass. If the time needed to complete this natural reclamation is too long the process can be hastened by irrigation to assist in washing out the salt, or salt-resisting crops may be planted. Asparagus, onions, sorghum, and beets withstand large quantities of salt in the soil, and if the soil is such as to be acceptable to any of these crops they will prove profitable.

AGRICULTURAL VALUE OF SALT MARSHES.

To determine the agricultural value of such lands, several samples of the salt marsh areas around Oyster Bay, on Long Island, were collected and subjected to laboratory examination. These are very probably representatives of much larger areas of salt marsh, and the results of their examination will no doubt prove of interest to owners of salt marshes all along the coast.

As has been indicated, there are many kinds of salt marshes—some merely bare mud flats without vegetation, and others with a heavy growth of grass and with a sod a foot or more thick. In one locality such differences are due to the age of the marsh, and the two cases mentioned can be considered as representing youth and old age in marsh growth.

The two tables show the results of the laboratory examinations of the Oyster Bay samples. Sample No. 5379 was collected from the tidal mud flat in the west end of Lloyd's Harbor, and represents the soil on which the salt marsh grows, or, in other words, is the salt marsh in youth. At low tide this mud flat is only a foot or eighteen inches above the level of the water in the harbor, but at high tide it is covered with salt water four or five feet deep. At the present time the eel-grass has just commenced to grow on the mud, and it is found in large, round hommocks dotting the mud flat. These hommocks will gradually spread until the eel-grass is growing over the entire flat. The growing grass greatly retards the flow of the water as the tide rises and flows and the deposition of the sediment will be hastened. The chemical analyses of this mud show it to be fairly rich in lime, abundant in potash and with an adequate supply of phosphoric acid. The 7 per cent of organic matter will keep the clay soil in good tilth. The amount of soluble matter (2.16 per cent), which an analysis showed to be almost entirely from sea water, would prevent useful plant growth other than salt grasses. The drainage of this flat would permit the washing out of this salt.

MECHANICAL ANALYSES OF TIDE MARSH SOILS FROM NEW YORK.

	Locality of soil.	Sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.
5379	Mud from tidal flat, west end Lloyd's Harbor, 0-6 inches	13.2	44.8	42.0
5375.	Subsoil from outer marsh, Center Island, 36-66 inches	28.0	44.9	27.1
5378.	Subsoil from inner marsh, Center Island, 24-72 inches	38.0	37.1	24.9

CHEMICAL ANALYSES OF TIDE MARSH SOILS FROM NEW YORK.

Composition.	5379 Soil 0-6 in.	5374 Soil 0-36 in.	5375 Subsoil 36-66 in.	5376 Soil 0-12 in.	5377 Subsoil 12-24 in.	5378 Subsoil 24-72 in.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Lime (CaO)	0.48	......	0.31	......	......	0.41
Potash (K_2O)	0.57	......	0.57	......	......	0.68
Phosphoric acid (P_2O_5)	0.16	......	0.14	......	......	0.12
Organic matter	7.18	29.00	5.36	34.70	25.49	10.90
Soluble in water	2.16	4.07	2.55	1.87	3.87	3.56

Two marshes on Center Island which are being drained were examined. These marshes—an inner marsh and an outer marsh—are separated by a narrow neck. Across this neck a causeway had been built and sluice gates placed in the culvert under the causeway. The gates were not carefully watched and the tide water backed up on the inner marsh several times. Notwithstanding this, the inner marsh was much fresher. The outer marsh, however, was covered at high tide twice a day and contained a large amount of salt. Both of these marshes had a sod about one foot thick and below this was decomposing sod to a depth of three feet, and then came the eel-grass mud, very similar to that collected in the west end of Lloyd's Harbor.

Samples No. 5374 and No. 5375 were taken from the outer marsh and represent the sod and decomposing grass roots and the underlying eel-grass clay respectively. The plant food analysis of the clay shows it to be similar to the mud from Lloyd's Harbor. The amount of soluble salt in both soil and subsoil is seen to be high for plants other than salt grasses. The sod is so light and tough that to decompose it thoroughly for a seed bed would require several years; therefore, it is likely that burning will be found the best method. It is interesting to note that the burning of these salt marsh soils causes part of the soluble matter to disappear, so that afterward the amount of soluble matter is smaller than before burning.

Samples No. 5,376, No. 5,377, and No. 5,378 were collected from the inner marsh. The first two are the sod and decomposing sod respectively and the last is the underlying eel-grass clay. The plant food analysis shows this clay to be very similar to the Lloyd's Harbor mud. The percentage of soluble salts in the surface foot of the inner marsh is lower than that in any of the other samples. This shows that a start toward sweetening has been made by the simple shutting out of the sea water. The drainage of this inner marsh is in progress and three samples of the drainage water collected while the ditch was in process of construction showed a salt content of 525, 860, and 860 parts salt per 100,000 parts of water. If this drainage keeps up, the marsh will in a short time be much sweetened. The soil in this inner swamp is also very light and should be burned if the intention is to cultivate the soil.

SUMMARY.

Salt marsh lands have long been considered the most fertile and valuable of lands. Practically no reclamation has been attempted in America, and that which has been attempted has in many cases been a failure or has been abandoned. There are well established methods in use in the reclamation of salt marshes and if these were used the work should be successful. There has never been a known case of failure to effect complete reclamation, in which all proper precautions were taken. After reclamation the lands are very fertile and should repay the expenditure of reclaiming them. It is generally conceded that one acre of reclaimed salt marsh land is worth four or five acres of upland, and, according to the well substantiated figures quoted from Shaler earlier in this article, the cost of reclamation should not exceed one-fifth of the final value of the land.

THOS. H. MEANS, Assistant.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Spanish Prizes for Gratings and Filters.—Under date of September 27, 1901, Deputy Consul-General Hanauer, of Frankfort, reports:

The municipal authorities of Madrid, Spain, have offered a prize of 3,000 pesetas ($450) for the best model of a grating for draining openings in street pavements; and another of the same amount for a filter for water pipes, which must have a capacity for filtering 800 liters (211 gallons) of water per hour. Models and descriptions must be submitted within two months. American manufacturers may find it profitable to submit models and bids for supplying these articles.

British Demand for Spectacle Frames.—Consul Marshal Halstead writes from Birmingham, October 11, 1901, that he has received the following from a merchant:

"I am a manufacturer of spectacle frames and engage about ten men. I could get, I think, sufficient work for twenty or thirty men, and before enlarging my business I wish to get quotations from American manufacturers of the separate parts of spectacle and eyeglass (folders, etc.) frames, especially the small stampings used for the nose bridge and spring joints. Will you please put me in possession of the names and addresses of the American firms who make such stampings and parts of spectacle frames?"

The consul adds:

I will be glad to place any American manufacturer of spectacle parts and frames into communication with the person who makes this inquiry, and will turn over to him any quotations sent me; but it should be always understood that, without reflecting on either party, a consul of the United States assumes no responsibility when putting firms into business communication, and the usual inquiries should be made.

Passenger Service Between Odessa and Germany.—Consul-General Hughes sends the following from Coburg, October 5, 1901:

On October 1, 1901, the Russian Southwest Railroad opened a direct passenger service between Odessa and the German cities of Breslau, Berlin, Leipzig, Bremen, and Hamburg. Part of the route will be conducted via Austrian railroads. Traveling either way, cars must be changed at Wolotschisk, as the Russian railways have a larger gage than other European roads.

Typesetting Machines in Germany.—The consul at Munich, Mr. Worman, writes from Westport, N. Y., October 24, 1901, that, according to the tax list recently published, 275 German printing establishments distributed over 147 places are using 532 typesetting machines, employing 816 persons. The weekly wages run between 18 and 60 marks ($4.28 and $14.28). The results achieved vary in the different machines between 2,500 and 9,000 letters. There are two systems in use, the linotype and the typograph.

Importation of Farming Implements into Turkey.—Under date of October 9, 1901, Mr. Eddy, secretary of legation at Constantinople, sends translation of a circular note from the Porte relative to the importation of farming implements into the Ottoman Empire, as follows:

By virtue of a decision of the Imperial Government, the limit fixed for the importation, free of customs duty, of the farming implements mentioned in the appended list, has been prolonged by ten years, beginning from August 4 ultimo (old style). Iron scythes with wooden handles, which figure in this list, returning into the category of tools of old system, will be subjected to the entrance duty.

LIST OF AGRICULTURAL IMPLEMENTS FREE FROM DUTY.

Plows, iron, with wooden handles, worked by hand, horse power, or steam; winnowing forks, of wood or iron, worked by hand, steam, or water power; reapers, binders, hayrakes, harrows, cultivators, rollers, sowers; machines for digging potatoes and beets, for cleaning rice, for crushing seeds and extracting oil, for pulverizing dirt and manures; sieves for cleaning and separating grain; thrashing machines, worked by hand, animal, steam, or water power; sawmills, lawn mowers; machines for turning and airing grass, called "Catona;" iron cultivators, called "Muzg;" pulverizers for manure, called "Mihdjem;" machines for cutting beets and for crushing grains, corn, and seeds for animal food; sprayers and garden syringes, sickles, scythes, hoes worked by hand or animal power; sprinklers; machines for distributing fertilizers, for making bales of hay; rakes with grappling hooks, and machines for making and tying bundles of hay.

Glass Works in Spain.—Consul-General Hughes reports from Coburg, October 10, 1901:

The German press says that at Gijon, on the north coast of Spain, a company has been started, with a capital of 6,000,000 pesetas ($1,158,000), for the purpose of establishing glass works and flour mills. Among the goods required are glass-working machinery, fire-proof clay, and calcined firestone. Americans might bid for these supplies.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Ozonatine is a fragrant air-purifying preparation consisting of dextro-gyrate turpentine oil scented with slight quantities of fragrant oils.—Pharmaceutische Rundschau.

To Paste Linoleum on Iron Stairs.—Use a mixture of glue, isinglass and dextrin, which, dissolved in water and heated, is given an admixture of turpentine. The strips pasted down must be weighted with boards and brick on top until the adhesive agent has hardened.—Die Werkstatt.

Extrait Automobile.—

Benzoic acid	6 grammes
Geranium oil	3 grammes
Sandal oil, East Indian	5 grammes
Vanilla tincture	30 grammes
Neroli oil	5 grammes
Jasmin extrait	250 grammes
Spirit (80 per cent)	400 grammes
Spirit of sal ammoniac (0.910)	5 drops

—Drogistische Rundschau.

Production of Vienna Hat Stiffening.—For the preparation of Vienna hat stiffening the Oesterreichische Drogisten Zeitung gives the following recipe: Shellac 1 kilo, resin ⅛ kilo, very strong spirit of wine ⅛ liter, dissolved in the heat; and on the other hand: A Dammar resin 60 grammes, sandarac 60 grammes, elemi 40 grammes, dissolved hot in 1-6 liter of pure turpentine oil; both solutions are mixed together warm. After the cooling a sirupy liquid should result; if the mass is too thick, spirit is added until the desired consistency is attained.

Microscopic and Chemical Composition of Various Poudres de Riz.—B. Setlik and R. Urban have microscopically and chemically examined poudres de riz (skin powders) of various origin and found that the fat powders consist chiefly of finely ground talc. In one of the powders corn-starch was found instead of rice-starch, and in another wheat-starch.

	Moisture.	Ash.	Starch.	Talc.	ZnO.	
French powder	6.62	53.6	39.78	53.02	—	Very fine
Parisian powder	9.24	27.10	64.50	23.06	3.74	contains corn starch.
Prague powder	7.94	35.96	56.10	31.79	3.75	Talc, coarsely ground.
Prague fat powder	6.07	55.05	39.07	54.86	——	
Berlin fat powder	8.7	65.85	30.50	41.30	0.25	Yellowish

—Casopis pro prumsyl chemicky through Chemiker Zeitung.

Odor of Automobiles.—The unpleasant odor of the motor vehicles, especially those propelled by petroleum, is ascribed, rather than to the imperfect combustion of the petroleum gases, to the burning of the lubricating material used for greasing the explosion cylinder, which as a rule possesses by far too low a flash point. It will be well to pay attention to the following statements of an expert who has undertaken to keep the penetrating odor away from his automobiles. In the case of motor cylinders cooled by water the lubricating oil should possess a flash point of not less than 205 deg. C., while the cylinders cooled by air require an oil whose flash point should be above 260 deg. C.

Freund has made interesting observations regarding the relations of automobilism and aeronautism. He states that it has been possible of late to build benzine motors with a proper weight of only 6 kilos for each effective horse power. Such a motor serving for automobile purposes has been used by Santos-Dumont at Paris in his dirigible balloon.

A 10 horse power motor, therefore, weighs only 60 kilos, a result which would have been thought impossible but a few years ago.—Zeitschrift fuer Automobil-Industrie und Motorenbau.

Chemical Process for the Extraction of Metallic Tin from Scraps of Sheet Tin and Other Waste Containing the Metal (Process of M. Wirtz-Preto).—Sheet tin is generally employed in the manufacture of boxes and vessels of different kinds. About 75 per cent of this sheet tin remains in the form of scraps, without use or profit in industry.

There are different processes for the extraction of tin from this waste, of which the most advantageous now employed appears to us to consist in dissolving the tin in a lixivium of caustic soda in order to obtain sodium stannate. The inventor has sought for a new process, which he declares economical, in order to separate from this waste the metallic tin adhering to the iron. The process consists in treating the waste of sheet tin and other residues containing tin with chlorhydric acid of 22 deg. Baumé, so as to obtain a solution of soluble tin protochloride containing an excess of acid. In this solution metallic zinc is introduced, which is attacked by the excess of acid, forming zinc chloride, with a disengagement of hydrogen, which reacts at the same time on the tin protochloride and forms a precipitate, whose color varies from gray to silver-white. This precipitate floats on the liquid and has a consistency sufficient for its easy collection by means of an enamel spoon. It is afterward readily pressed into the form of blocks, bricks, or cakes. The metallic tin is then separated in a reverberatory furnace, and the molten metal is molded by pressure into the desired form.

None of the operations of this process requires special apparatus. Any of the known contrivances can be employed for the purpose. The quantity of the metallic zinc to be introduced into the solution containing an excess of acid is about 7 per cent of the weight of the tin waste subjected to treatment. The temperature required in the reverberatory furnace for separating the tin by melting is 250 to 300 deg. C.—La Revue des Produits Chemiques.

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